NASA

# Energy
## A Continuing Bibliography with Indexes

NASA SP-7043(37)
April 1983


National Aeronautics and Space Administration

25th Anniversary
1958-1983

## ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

| | |
|---|---|
| STAR (N-10000 Series) | N83-10001 - N83-16274 |
| IAA (A-10000 Series) | A83-10001 - A83-19623 |

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NASA SP-7043(37)

# ENERGY

## A CONTINUING BIBLIOGRAPHY WITH INDEXES

## Issue 37

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between January 1 and March 31, 1983 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1983
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Washington, DC

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# INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(37)) lists 1169 reports, journal articles, and other documents announced between January 1, 1983 and March 31, 1983 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The entries are arranged in eight major categories, with *IAA Entries* preceding *STAR Entries* in each category. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Six indexes -- subject, personal author, corporate source, contract number, report number, and accession number -- are included.

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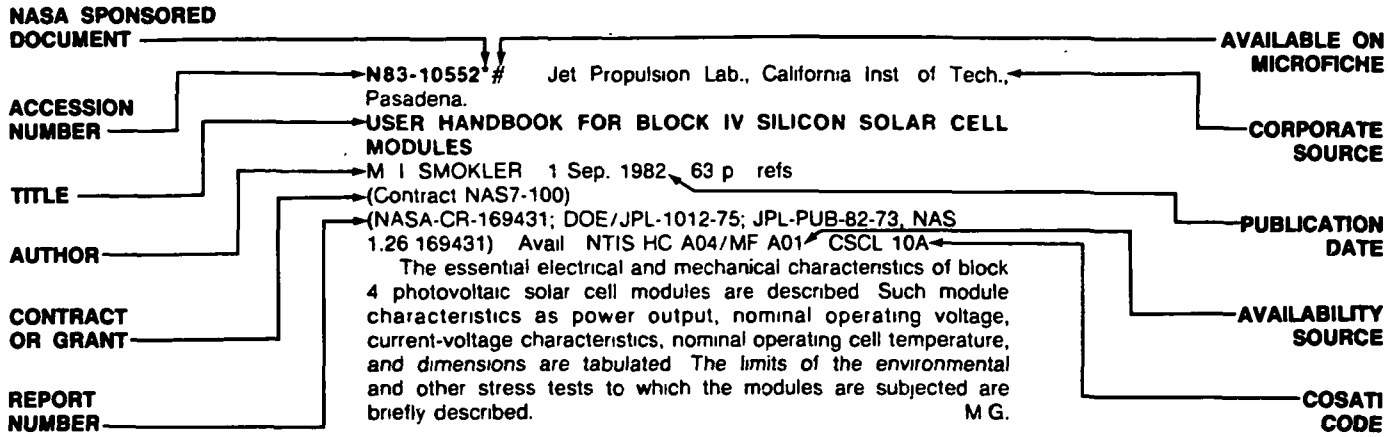


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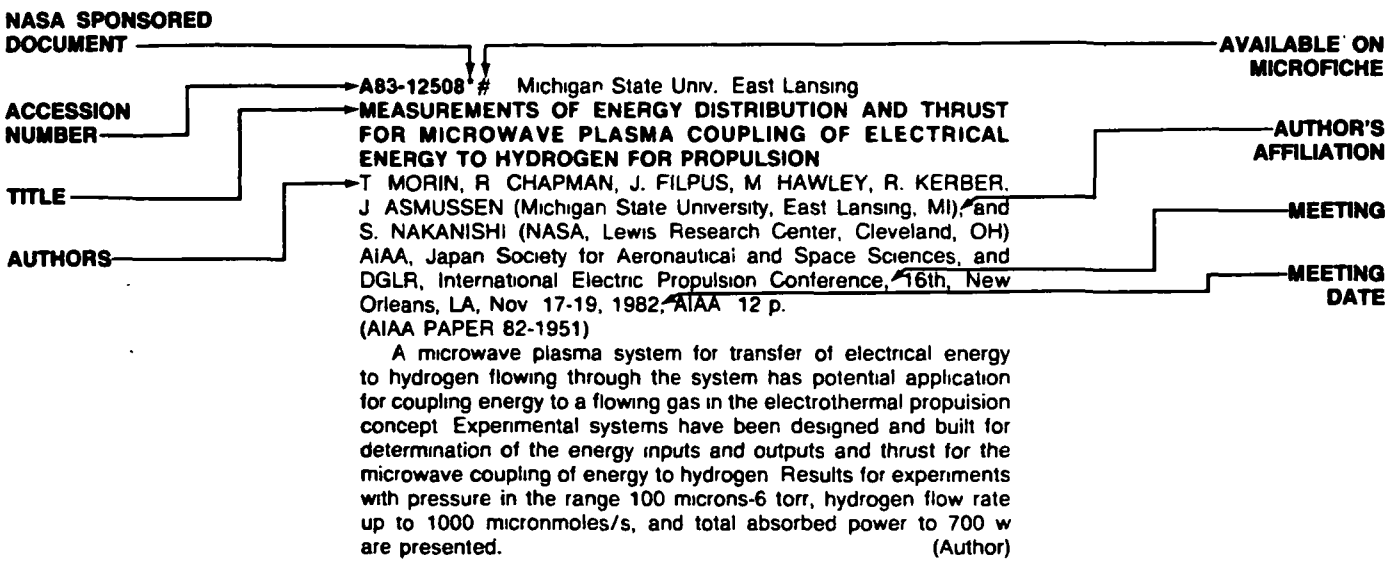

## A Listing of Energy Bibliographies Contained in This Publication:

# ENERGY

*A Continuing Bibliography (Issue 37)*

APRIL 1983

## 01

## ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

Includes energy requirements, energy conservation, and environmental impacts of energy systems.

**A83-10069**
**THE USE OF NEAR COLOR INFRARED PHOTOGRAPHY TO ASSESS THE IMPACT OF THE OIL AND NATURAL GAS INDUSTRY ON LOUISIANA'S WETLANDS**
J. A. MONTE (Greenhorne and O'Mara, Inc., Riverdale, MD) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1981, p. 768-777. refs

**A83-10186*#** Mitre Corp., McLean, Va.
**ESTIMATION OF AIRCRAFT FUEL CONSUMPTION**
B. P. COLLINS (Mitre Corp., McLean, VA) Journal of Aircraft, vol 19, Nov. 1982, p. 969-975. U.S. Department of Transportation refs
(Contract NAS1-16430; DOT-FA79WA-4184, DOT-RS57-80-C-00103)
(Previously cited in issue 14, p. 2299, Accession no. A81-33883)

**A83-10439#**
**ATTEMPT TO DETERMINE THE POWER DEMAND OF A HELICOPTER CONTROL SYSTEM ON THE BASIS OF FLIGHT TESTS [PROBA OKRESLENIA OBCIAZEN UKLADU STEROWANIA SMIGLOWCA W SWIETLE BADAN W LOCIE]**
B. CIAS, J. KRECISZ, and J. MORAWSKI Instytut Lotnictwa, Prace, no. 87, 1981, p. 3-18. In Polish. refs

*The objective of the present study was to determine the power* produced by the control servos of a helicopter under real flight conditions. A statistical analysis of flight test results showed that the nominal power of the servos actually utilized is relatively low. This may be associated with a low value of the servo synchronism coefficient, due probably to the sequential manner in which particular control channels are operated, typical for manual *control.* B.J.

**A83-11156*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**ECONOMIC MODELING OF FAULT TOLERANT FLIGHT CONTROL SYSTEMS IN COMMERCIAL APPLICATIONS**
G. B. FINELLI (NASA, Langley Research Center, Hampton, VA) In: NAECON 1982; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 18-20, 1982. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. 635-642. refs

This paper describes the current development of a comprehensive model which will supply the assessment and analysis capability to investigate the economic viability of Fault Tolerant Flight Control Systems (FTFCS) for commercial aircraft of the 1990's and beyond. An introduction to the unique attributes *of fault tolerance and how they will influence aircraft operations* and consequent airline costs and benefits is presented. Specific modeling issues and elements necessary for accurate assessment of all costs affected by ownership and operation of FTFCS are delineated. Trade-off factors are presented, aimed at exposing economically optimal realizations of system implementations, resource allocation, and operating policies. A trade-off example is *furnished to graphically display some of the analysis capabilities* of the comprehensive simulation model now being developed. (Author)

**A83-11896**
**WIND POWER FOR THE ELECTRIC-UTILITY INDUSTRY: POLICY INCENTIVES FOR FUEL CONSERVATION**
F. MARCH, E. H. DLOTT (Boston, First National Bank, MA), D. H. KORN (Arthur D. Little, Inc., Cambridge, MA), F. R. MADIO (Raytheon Corp., Lexington, MA), R. C. MCARTHUR, and W. A. VACHON (Arthur D. Little, Inc., Cambridge, MA) Research supported by the National Science Foundation Lexington, MA, D. C. Heath and Co., 1982. 170 p. refs
(Contract NSF PRA-80-00488)
$20

A systematic method for evaluating the economics of solar-electric/conservation technologies as fuel-savings investments for electric utilities in the presence of changing federal incentive policies is presented. The focus is on wind energy conversion systems (WECS) as the solar technology closest to near-term large scale implementation. Commercially available large WECS are described, along with computer models to calculate *the economic impact of the inclusion of WECS as 10% of the* base-load generating capacity on a grid. A guide to legal structures and relationships which impinge on large-scale WECS utilization is developed, together with a quantitative examination of the installation of 1000 MWe of WECS capacity by a utility in the northeast states. Engineering and financial analyses were performed, with results indicating government policy changes *necessary to encourage the entrance of utilities into the field of* windpower utilization. M.S.K.

**A83-12038**
**ICE DISTRIBUTION AND WINTER SURFACE CIRCULATION PATTERNS, KACHEMAK BAY, ALASKA**
L. W. GATTO (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, NH) Remote Sensing of Environment, vol. 12, Nov. 1982, p. 421-435. refs

The development of the hydropower potential of Bradley Lake, Alaska would considerably increase winter freshwater discharge into Kachemak Bay. This could result in increased ice formation and related problems. In order to investigate winter surface circulation in the bay and ice distribution patterns, Landsat MSS bands 5 and 7 and RBV imagery with 70 percent cloud cover or less taken between 1 November and 30 April each year from 1972 to 1980 were examined. The results show that surface water circulation is driven more by tidal forces than by wind stress. The circulation patterns indicate that if additional ice is formed from the increased winter discharge, a greater ice cover would accumulate along Homer Spit and be blown into the outer bay by the dominant northerly winter winds. S.C.S.

## 01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

**A83-12686**
**THERMAL INFRARED SENSING APPLIED TO ENERGY CONSERVATION IN BUILDING ENVELOPES /THERMOSENSE IV/; PROCEEDINGS OF THE MEETING, OTTAWA, ONTARIO, CANADA, SEPTEMBER 1-4, 1981**
R. A. GROT, (ED.) (National Bureau of Standards, Washington, DC) and J. T. WOOD (Data-Control Systems, Danbury, CT) Meeting sponsored by the SPIE - The International Society for Optical Engineering Bellingham, WA, SPIE - The International Society for Optical Engineering (SPIE Proceedings. Volume 313), 1982. 255 p
$40

Thermography applications in industrial plants and utility systems are considered. Topics discussed include aerial thermographic data interpretation, aerial infrared survey field evaluations for residential applications, and infrared thermography applications in relation to the Low-Cost Solar Array Program. Also considered are new trends in infrared technology, and training and standards regarding thermography. R.K.R.

**A83-14000**
**AIRLINE ECONOMICS**
G. W. JAMES, (ED.) (Air Transport Association of America, Washington, DC) Lexington, MA, D.C. Heath and Co., 1982 344 p
$35

This anthology is a compilation of recent ATA studies on airline economics. The background of industry economics is presented, and recent developments in the airline industry and the outlook for the future (e.g., changes in the U.S./international market, 1970-1980, and the impact of the Airline Deregulation Act) Finally, a summary is given of presentations by airline executives to the ATA/Stanford University Symposium on airline planning conducted in the summer of 1980; particular attention is given to marketing planning, financial planning

**A83-14517*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**THE SATELLITE POWER SYSTEM - ASSESSMENT OF THE ENVIRONMENTAL IMPACT ON MIDDLE ATMOSPHERE COMPOSITION AND ON CLIMATE**
R. C. WHITTEN, W. J. BORUCKI, C. PARK, L. PFISTER, H. T. WOODWARD (NASA, Ames Research Center, Moffet Field, CA), R. P. TURCO (R&D Associates, Marina del Rey, CA), L. A. CAPONE, C. A. RIEGEL (San Jose State University, San Jose, CA), and T. KROPP (Informatics, Inc., Palo Alto, CA) Space Solar Power Review, vol. 3, no 3, 1982, p. 195-221. refs
(Contract DE-AI01-79ER-10035)

Numerical models were developed to calculate the total deposition of watervapor, hydrogen, CO2, CO, SO2, and NO in the middle atmosphere from operation of heavy lift launch vehicles (HLLV) used to build a satellite solar power system (SPS). The effects of the contaminants were examined for their effects on the upper atmosphere. One- and two-dimensional models were formulated for the photochemistry of the upper atmosphere and for rocket plumes and reentry. An SPS scenario of 400 launches per year for 10 yr was considered. The build-up of the contaminants in the atmosphere was projected to have no significant effects, even at the launch latitude. Neither would there by any dangerous ozone depletion. It was found that H, OH, and HO2 species would double in the thermosphere. No measurable changes in climate were foreseen. M.S.K.

**A83-16191**
**MULTIVARIABLE STABILITY-MARGIN OPTIMISATION WITH DECOUPLING AND OUTPUT REGULATION**
M. G. SAFONOV (Southern California, University, Los Angeles, CA) and B. S. CHEN (Tatung Institute of Technology, Taipei, Republic of China) IEE Proceedings, Part D - Control Theory and Applications, vol. 129, pt. D, no. 6, Nov. 1982, p. 276-282. refs
(Contract F44620-76-C-0061; AF-AFOSR-80-0013)

A procedure is developed for maximizing frequency-weighted stability-margin singular values for a multivariable linear time-invariant feedback control system subject to design constraints requiring decoupling and asymptotic tracking in the presence of unstable command and disturbance signals and closed-loop stability. The results are derived using Sarason's H-infinity optimal interpolation results, together with a new multivariable realizability lemma (Author)

**A83-16516#**
**THE APPLICATION OF ENERGY SAVING CONCEPTS TO FUTURE FIGHTER/ATTACK AIRCRAFT DESIGN**
S. A. POWERS, H. H. DRIGGERS, and T. E. KRIEG (Vought Corp., Dallas, TX) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p. refs
(Contract N622691-81-C-0534)
(AIAA PAPER 83-0092)

A study of twenty Energy Saving Concepts as applied to an Advanced Fighter/Attack aircraft intended for an initial operational capability (IOC) of 1995 has been carried out. The results show that the use of Surface Launched Air Targeted Missiles, Advanced Engines, conformal external fuel tanks, variable sweep wings, advanced airfoils, relaxed static margin, and intelligent use of advanced structural materials can significantly reduce the fuel consumption of such an aircraft at a modest increase in Life Cycle Costs. (Author)

**A83-18812#**
**CASE FOR A SPACE CENTER IN THE ARABIAN GULF**
P. GRETTON-WATSON (Scicon Consultancy International, Ltd., London, England) Astronautics and Aeronautics, vol. 21, Jan 1983, p. 47-49.

Because all techniques for transporting natural gas from oil fields such as those of the Arabian Gulf countries, where it is presently being burned off, have serious technical drawbacks, it is suggested that energy-intensive industries be put near those sources of natural gas. The industry identified as being most attractive is a space launch center, located on the Arabian Gulf, that would be devoted to research projects involving large payloads. The hydrogen required by high performance launchers can be produced by methane by means of the stream-reforming process. The hydrogen would be liquefied by conventional techniques, using electricity derived from natural gas-fueled gas turbines. A combination of electricity, pressurized methane and liquefied natural gas would be used for the operation of space center engineering facilities. The low population density of the geographical region in question is noted as an advantage over existing facilities. O.C.

**A83-19150**
**FUEL SAVINGS IN AIR TRANSPORT**
J. L. RENTEUX and H. SCHROEDER Airport Forum, vol. 11, Dec. 1982, p. 36-40.

A summary of conclusions reached in a report by Eurocontrol on civil aircraft fuel conservation measures implementable by ATC is presented. The types of aircraft were categorized together with flight statistics. The average European flight was determined to be 320 nm, with total fuel consumed annually amounting to 16 Mtons. Routing changes were projected to save 4% of the total fuel consumed. Delays, if ameliorated, could account for 1,5% savings, while flight profile changes, if minimized, offer a 3.5-4.5% reduction. In total, from 4.9-5.8% of consumption can be saved in the short term, and an additional 4% in the medium term, i.e., 1985. Various additional steps, including improved training for ATCs,

links between the flight management computer and the ground-based computers, and start-up and take-off procedures improvements are outlined. D.H K.

**N83-10152#** *Technical Research Centre of Finland, Espoo* Chemical Lab.
**A THERMAL DESORPTION COLD-TRAP UNIT FOR GASCHROMATOGRAPHIC ANALYSIS OF GASEOUS ORGANIC POLLUTANTS**
V. KARLSSON and F. SCHULTING (Research Inst. for Environmental Hygiene, Delft, Netherlands) 1981 31 p refs
(PB82-206368; VTT-15/1981; ISBN-951-38-1284-7; ISSN-0358-5085) Avail: NTIS HC A03/MF A01 CSCL 07D

In atmospheric sampling, a preconcentration step is often necessary to raise the concentration of the pollutants above the sensitivity level of the detecting apparatus. During the work period at ING-TNO, a thermal desorption cold trap (TCT) unit was fitted up. The TCT unit was built for preparation of on solid sorbent material concentrated samples for further analysis. The optimum settings for efficient desorption as well as for cooling and heating of the cold trap were tested The desorption efficiency of the instrument was at least 95%. No cold spots or dead points were observed where the sample compounds could condensate and remain. The TCT unit did neither cause any peak broadening or separation problems. The developed technique was applied to ambient air and automobile exhaust analysis. Author

**N83-10302#** *Massachusetts Inst. of Tech., Cambridge.*
**ALTERNATIVE ELECTRIC GENERATION IMPACT SIMULATOR Final Summary Report**
J. GRUHL, D. COATE, and E. SCHWEPPE Aug. 1981 124 p refs Sponsored by Northeast Utilities Service Co.
(PB82-180324; MIT-EL-81-044) Avail: NTIS HC A06/MF A01 CSCL 13B

The potential for, and significance of, uncertainty in the energy technology assessment process was explored Technology assessments primarily from a methodological viewpoint. A general ideal methodology is developed and the potentials for incorporating uncertainties are described. The implementation of an ideal assessment methodology resulted in the coding of a simulator that should be viewed as a framework for assembling and manipulating information about the economics, emissions, ambient concentrations, and potential health impacts of different types and configurations of electric power generating facilities. The framework is probabilistic, and thus results in several measures of the range of various consequences, in other words a graphic display of the quality of the various predictions. The simulator is structured so that it is easy to improve the sophistication of certain manipulations, or to replace generic data, or update or add new data. A.R.H.

**N83-10401#** National Bureau of Standards, Washington, D.C.
**ECONOMIC EFFICIENCY IN THE SIZING OF RESIDENTIAL HEAT PUMPS Final Report**
J. LEVY and S. R. PETERSEN Jul. 1981 75 p refs
(PB82-179029; NBSIR-80-2176) Avail: NTIS HC A04/MF A01 CSCL 13A

A methodology to determine the optimal heat pump size, in terms of heating output capacity, for residential installations having annual heating requirements significantly greater than annual cooling requirements is presented. The optimal size heat pump is defined as the size for which total present value, life cycle heating and cooling costs are minimized Incremental energy savings from increasing the output capacity of the heat pump are calculated using hourly simulation models of heat pump and building performance. The dollar value of the incremental savings, is calculated and compared with incremental costs to determine the optimal heat pump size. A number of sensitivity analyses are performed to show that effects of changes in load size, degradation coefficients, power utilization efficiency, economic assumptions and geographic location on the optimal heat pump size. GRA

**N83-10429#** Trochoid Power Corp., Eden Prairie, Minn.
**POSITIVE DISPLACEMENT ROTARY VAPOR COMPRESSOR FOR VAPOR COMPRESSION Annual Report, Jan. 1981 - Jan. 1982**
R. H. ROCHE and P. B. STIELSTRA Feb. 1982 26 p
(Contract GRI-5080-342-0389)
(PB82-227620; GRI-80/0134) Avail: NTIS HC A03/MF A01 CSCL 13G

Economic savings are realized by the use of mechanical vapor compression heat pumps to upgrade waste steam to process-useful temperatures Engineering, design and manufacturing were completed on an advanced positive displacement rotary vapor compressor. Significant features of this proof of concept compressor are its epitrochoidal design, its ability to achieve high compression ratios, high speed valves, and pressurized lubrication and temperature-conditioning systems. A compressor test facility was built incorporating a variable speed drive and a steam supply system capable of subatmospheric inlet pressures. GRA

**N83-10481#** *Bureau of Mines, Pittsburgh, Pa.*
**COMPUTERIZED, REMOTE MONITORING SYSTEMS FOR UNDERGROUND COAL MINES: FIRES AND EXPLOSIVE ATMOSPHERES**
J. H. WELSH Apr 1982 15 p refs
(PB82-221359; BM-IC-8875) Avail: NTIS HC A02/MF A01 CSCL 08I

The use of computerized, continuous remote monitoring systems for fire and explosive atmosphere safety in underground coal mines was studied The effects of these systems on the safety level in mines are investigated, and the relationship between mine safety regulations and computerized, continuous, remote monitoring is analyzed. M.G.

**N83-10499** International Inst. for Applied Systems Analysis, Laxenburg (Austria).
**ENERGY FOR AGRICULTURE IN PAKISTAN**
M JAMEEL May 1982 41 p refs
(IIASA-RR-82-20; ISBN-3-7045-0040-2) Avail: Issuing Activity

The energy implications of different farm mechanization and macronutrient supply scenarios were examined. Results show that up to the year 2000, fertilizer production and irrigation-drainage account for 45 % and 40 %, respectively, of total energy input to agriculture. Tractors, threshers, and pesticides share the rest. Author (ESA)

**N83-10506*#** Department of Energy, Washington, D. C.
**NATIONAL PHOTOVOLTAIC PROGRAM**
M. PRINCE *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj Integration Meeting p 55-60 Apr. 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

Department of Energy budget plans for 1982 are presented including general funding levels and key program achievements. Activities that are cost-shared with industry are summarized and cell efficiency improvements with time and industry accomplishments are discussed. J.M.S.

**N83-10547*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**POTENTIAL BENEFITS FROM A SUCCESSFUL SOLAR THERMAL PROGRAM**
K. L. TERASAWA and W. R. GATES *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 295-318 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10A

Solar energy systems were investigated which complement nuclear and coal technologies as a means of reducing the U.S. dependence on imported petroleum. Solar Thermal Energy Systems (STES) represents an important category of solar energy technologies. STES can be utilized in a broad range of applications servicing a variety of economic sectors, and they can be deployed in both near-term and long-term markets. The net present value of the energy cost savings attributable to electric utility and IPH applications of STES were estimated for a variety of future energy

cost scenarios and levels of R&D success. This analysis indicated that the expected net benefits of developing an STES option are significantly greater than the expected costs of completing the required R&D. In addition, transportable fuels and chemical feedstocks represent a substantial future potential market for STES. Due to the basic nature of this R&D activity, however, it is currently impossible to estimate the value of STES in these markets. Despite this fact, private investment in STES R&D is not anticipated due to the high level of uncertainty characterizing the expected payoffs. B.W.

**N83-10550*#** Advanco Corp., El Segundo, Calif.
**PANEL DISCUSSIONS: INDUSTRIAL SUPPORT SECTOR REQUIREMENTS**
B. WASHOM *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 339-353 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10A

Industrial support was the subject of a panel discussion on solar energy technology. Members of various energy-related businesses and agencies were present. Topics cofered include: (1) solar collectors; (2) solar energy policy; (3) government/industry relations; and (4) economic factors which influence the use of solar energy. B.W.

**N83-10551*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SOLAR THERMAL TECHNOLOGIES BENEFITS ASSESSMENT: OBJECTIVES, METHODOLOGIES AND RESULTS FOR 1981**
W. R. GATES Jul. 1982 45 p refs
(Contract NAS7-100; DE-AM04-80AL-13137; JPL PROJ. 5106-23)
(NASA-CR-169373; DOE/JPL-1060-55; JPL-PUB-82-70; NAS 1.26:169373) Avail: NTIS HC A03/MF A01 CSCL 10A

The economic and social benefits of developing cost competitive solar thermal technologies (STT) were assessed. The analysis was restricted to STT in electric applications for 16 high insolation/high energy price states. Three fuel price scenarios and three 1990 STT system costs were considered, reflecting uncertainty over fuel prices and STT cost projections. After considering the numerous benefits of introducing STT into the energy market, three primary benefits were identified and evaluated: (1) direct energy cost savings were estimated to range from zero to $50 billion; (2) oil imports may be reduced by up to 9 percent, improving national security; and (3) significant environmental benefits can be realized in air basins where electric power plant emissions create substantial air pollution problems. STT research and development was found to be unacceptably risky for private industry in the absence of federal support. The normal risks associated with investments in research and development are accentuated because the OPEC cartel can artificially manipulate oil prices and undercut the growth of alternative energy sources. S.L.

**N83-10562*#** Computer Sciences Corp., Hampton, Va.
**NECAP 4.1: NASA'S ENERGY COST ANALYSIS PROGRAM THERMAL RESPONSE FACTOR ROUTINE Progress Report, 1981 - 1982**
M. R. WEISE Aug. 1982 26 p
(Contract NAS1-16078)
(NASA-CR-165982; NAS 1.26:165982) Avail: NTIS HC A04/MF A01 CSCL 10A

A thermal response factor is described and calculation sequences and flowcharts for RESFAC2 are provided. RESFAC is used by NASA's (NECAP) to calculate hourly heat transfer coefficients (thermal response factors) for each unique delayed surface. NECAP uses these response factors to compute each spaces' hourly heat gain/loss. S.L.

**N83-10566*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**NECAP 4.1: NASA'S ENERGY-COST ANALYSIS PROGRAM FAST INPUT MANUAL AND EXAMPLE**
R N. JENSEN and D. L. MINER (Computer Sciences Corp., Hampton, Va.) Aug. 1982 74 p refs
(NASA-TM-83241; NAS 1.15:83241) Avail: NTIS HC A04/MF A01 CSCL 10A

NASA's Energy-Cost Analysis Program (NECAP) is a powerful computerized method to determine and to minimize building energy consumption. The program calculates hourly heat gain or losses taking into account the building thermal resistance and mass, using hourly weather and a response factor method. Internal temperatures are allowed to vary in accordance with thermostat settings and equipment capacity. NECAP 4.1 has a simplified input procedure and numerous other technical improvements. A very short input method is provided. It is limited to a single zone building. The user must still describe the building's outside geometry and select the type of system to be used. Author

**N83-10583#** Northern Energy Corp., Boston, Mass.
**SMALL-SCALE WASTE-TO-ENERGY SYSTEMS: A STATE-OF-THE-ART REPORT**
A. L. WHITE *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 65-71 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

For industry and local government, small scale waste to energy systems represent an increasingly attractive option to enhance energy security, control energy costs, generate revenues and alleviate landfill constraints. Projects are characterized by: a mix of modular and waterwall systems; small and medium size industrial steam customers; a nascent interest in cogeneration; the utilization of a variety of public financing instruments; and growing vendor involvement in facility operations. Experience also points to the pivotal role of one or a few persistent individuals during the project implementation process. Recent operating history is likely to provide the foundation for steady growth in the number of small scale systems during the next decade. Author

**N83-10585#** Oak Ridge National Lab., Tenn. Chemical Technology Div
**ANFLOW: CHARACTERIZATION AND DEVELOPMENT OF AN ENERGY CONSERVING WASTEWATER TREATMENT SYSTEM**
R. K. GENUNG, C. W. HANCHER, and A. L. RIVERA *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop Workshop p 92-109 Feb. 1982 refs
(Contract W-7405-ENG-26)
Avail: NTIS HC A16/MF A01

An energy conserving wastewater treatment system based on an anaerobic upflow (ANFLOW) bioreactor containing fixed films of microorganisms was developed. The development of a wastewater treatment system which has significant energy conservation and/or energy production advantages as well as lower capital costs when compared to conventional wastewater treatment systems is discussed. E.A.K.

**N83-10588#** Middlesex County Dept. of Solid Waste Management, New Brunswick, N.J.
**INSTITUTIONAL FACTORS IN RESOURCE RECOVERY CO-DISPOSAL DEMONSTRATION PROJECT, MIDDLESEX COUNTY, NEW JERSEY, SPRING 1980 - SUMMER 1981**
R M. MCCARTHY *In* Argonne National Lab. Proc. of US Dept. of Energy/Argonne Natl Lab. Contractors' Res. and Develop. Workshop p 140-156 Feb. 1982 refs
Avail: NTIS HC A03/MF A01

A proposal to provide 1200 tons per day of solid waste disposal combined with 200 tons per day of sludge disposal was presented. The prospects for codisposal in Middlesex County were analyzed. Technically, codisposal was possible, however, it lacked a proven track record. Proposal for a resource recovery plant to be designed,

built, and operated was acknowledged as consistent with County planning. E.A.K.

**N83-10589#** Gilbert/Commonwealth, Reading, Pa.
**ENERGY RECOVERY AND COGENERATION FROM AN EXISTING MUNICIPAL INCINERATOR**
D. F. CREGO, V. L. ELLER (Central Wayne County Sanitation Authority), and J. W. STEPHENSON (Havens and Emerson, Inc.) *In* Argonne National. Lab. Proc. of US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 163-180 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

An existing 727 TPD incinerator burning mixed municipal refuse was deemed to be a feasible candidate for a cogeneration energy retrofit. It is indicated that equipment and construction of the retrofit will cost $17.6 million or $24,200/rated tonne in 1980 dollars; air pollution control equipment will cost 10.4 million or $14,300/tonne. Furnace temperature and gas samplings along with pilot air pollution control equipment tests were conducted. Refuse was characterized on both wet and dry seasons. Final design is based upon burning 155,000 TPY of refuse from which can be generated, sufficient steam and electricity for inhouse use and an additional amount of 64 million kWh for sale. E.A.K.

**N83-10593#** Systech Corp., Xenia, Ohio.
**CONVERSION OF MUNICIPAL SOLID WASTE TO ENERGY, JACKSONVILLE, FLORIDA**
R. FROUNFELKER and H. BELENCAN *In* Argonne National Lab. Proc. of US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 226-245 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

A 227 megagram per day prototype auger combustor system is described and performance tests are discussed. The system is a two chamber, starved-air incenerator so named because of the auger located within the primary chamber which tumbles and moves the waste through the system. The feasibility evaluation of resource recovery in the city of Jacksonville, Florida, involved the determination of the following: (1) the amount and characteristics of the solid waste; (2) the location and requirement of candidate energy customers and materials markets; (3) the applicable incineration/heat recovery and resource recovery technologies; and (4) the institutional, legal, and environmental requirements for constructing a facility. The marketing plan developd to define the specific steps required to employ a waste-to-energy technology in the Jacksonville area is also discussed. M.G.

**N83-10600#** Oregon Inst. of Tech., Klamath Falls. Geo-Heat Center.
**COMMUNITY HEAT-PUMP SYSTEM, KLAMATH COUNTY, OREGON**
Mar. 1982 19 p
(Contract DE-FG06-79ET-17156)
(DE82-015106; DOE/ET-17156/T21) Avail: NTIS HC A02/MF A01

The possibility of heating 47 proposed homes on a new development site using ground water source heat pumps is discussed. The pumping temperatures are 780 F for No. 2 Well, neither temperature is hot enough for direct space heating. Temperature profiles of the wells indicate that a temperature hot enough for direct heating (about 1100 F or above) cannot be found at reasonable depth. Since direct geothermal heating is not a practical alternative, the tract will be all-electric since this is the only energy source in the area. The economic feasibility of a community heat pump system that would reduce the amount of electrical energy required to service the homes is addressed. DOE

**N83-10612#** Enviro Control, Inc., Rockville, Md.
**PROCEEDINGS OF THE CONFERENCE ON ENERGY CONSERVATION: RETROFIT OF MUNICIPAL WASTEWATER TREATMENT FACILITIES**
Feb. 1982 270 p refs Conf. held in Los Angeles, 23-25 Jun. 1981
(Contract W-31-109-38-5830)
(DE82-013710; ANL/CNSV/TM-95) Avail: NTIS HC A12/MF A01

The concepts of the roles of heat and temperature, ventilation and water removal when organic material is assembled into a self insulating mass are summarized. The practical application of these concepts in static pile configuration or the Rutgers process are outlined. The concepts and means of application are relevant to all design approaches whether or not a reactor structure is involved, whether the process is batch or continuous, and whether the mass is agitated or static. DOE

**N83-10618#** Forschungsstelle fuer Energiewirtschaft, Munich (West Germany).
**STUDY OF THE POSSIBILITIES OF MORE RATIONAL USE OF ENERGY IN THE SECTOR OF TRADE AND COMMERCE, PART 1 Final Report, Aug. 1981**
K. F. EBERSBACH, A. FISCHER, G. LAYER, W. STEINBERGER, M. WEGNER, and B. WIESNER Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 146 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-076-PT-1; ISSN-0340-7608) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 30,50

The energy demand in trade and commerce was analyzed. Measures to improve the energy demand structure are presented. In several typical firms, like hotels, office buildings, locksmith's shops, motor vehicle repair shops, butcher's shops, laundries and bakeries, energy consumption was surveyed and statistically evaluated. Subjects analyzed are: the development of the energy supply; the technology of energy application; the final energy demand broken down into demand for light, power, space heating and process heat as well as the demand for cooling; the daily and annual load curve of energy consumption and its dependence on various parameters; and measures to improve the structure of energy demand. The detailed measurement points out negligences in the surveyed firms and shows some possibilities for likely energy savings. In addition, standard values for specific energy consumption are obtained. Author (ESA)

**N83-10628#** Research Inst. of National Defence, Stockholm (Sweden). Systems Analysis Dept.
**RUNNING HOT WATER: A SYSTEMS APPROACH TO ENERGY CONSERVATION**
P. WULFF Mar. 1982 25 p refs Sponsored by Swedish Energy Research and Development Commission
(FOA-C-10202-M2) Avail: NTIS HC A02/MF A01

Ways to conserve energy in domestic hot water systems are discussed. Examination of the Swedish situation shows that centralized systems, where water heating is a subsidiary of space heating, waste energy because water cools in the pipes after use, and the entire system must operate in summer. Also, water temperature is often much higher than required. Solar panels, individual water heaters, heat pumps, and heat exchangers could contribute to energy conservation, but changes in consumer behavior can also be extremely effective. For example, dish washing energy requirements were reduced by 80% in one neighborhood by giving each apartment a plastic bowl for washing up. Author (ESA)

## 01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

**N83-10636#** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
**GEOTHERMAL ENERGY DEVELOPMENT IN THE UNITED STATES Final Report, 1976 - 1981**
Oct. 1981 144 p refs
(Contract DE-AL01-79ET-27025; EX-76-A-36-1008; N00024-81-C-5301)
(PB82-215146; JHU/APL/QM-81-130) Avail: NTIS HC A07/MF A01 CSCL 08I

Research on geothermal energy utilization is discussed. Topics include: developing a background in geology, hydrology, and reservoir analysis; establishing the marketability of geothermal energy; colocating users with resources; the transfer of technology; and establishing the beginnings of a geothermal industry infrastructure. Legal, institutional, and economic issues were addressed, as well as information exchange and assistance in state planning through the development of state prospectuses and scenarios. R.J.F.

**N83-10642#** Greater Egypt Regional Planning and Development Commission, Carbondale, Ill.
**IMPACT OF ALTERNATE ENERGY SOURCES IN THE GREATER EGYPT REGION: FRANKLIN, JACKSON, JEFFERSON, PERRY AND WILLIAMSON COUNTIES, ILLINOIS Final Report**
Jun. 1981 142 p
(Contract EDA-06-05-11007-10)
(PB82-181090; GERPDC-81-603) Avail: NTIS HC A07/MF A01 CSCL 10A

Economic and environmental aspects of alternate energy sources for the five county Greater Egypt Economic Development District in Southern Illinois are discussed. Various energy sources available, including coal, oil, gas, coal, solar and geothermal are discussed. GRA

**N83-10651#** Schmidt Reuter Engineering Consulting Co., Cologne (West Germany).
**CONSERVING ENERGY BY IMPROVING THE QUALITY OF THE AIR PURIFYING AND AIR CONDITIONING SYSTEMS Final Report, Jun. 1981**
U. KNIEL and W. MOOG Bonn Bundesministerium fuer Forschung und Technologie May 1982 436 p refs Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-067; ISSN-0340-7608) Avail: NTIS HC A19/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 60

After reviewing different air pollution elements and their measurement methods, a definition of 'good air' quality is given, and the necessity of good air filtration is addressed. A filter system, based on the conventional adiabatic diffusion chamber, was developed and a pilot plant was constructed. The activation elements in the pretreatement stage, comprised of an ionizator, a wet surface cooler and a prehumidifier, combine with the separating elements, comprised of packing materials, an electronic collector and a cooling washer. Water analyses show that specified raw water cannot be used as usual in an air washer without purification. If osmotically purified water is used in the washing operation, an increased jet pressure may be used with a positive effect on the particle concentration in the air behind the washer. The filtering element is able to entirely eliminate SO2, to reduce nitrogen oxides to 15%, carbon oxides and dust particles to such an extent that it is possible to reduce fresh air introduction by 20%.
Author (ESA)

**N83-10654#** Environmental Protection Agency, Research Triangle Park, N.C. Office of Air, Noise and Radiation.
**COMPILATION OF AIR POLLUTANT EMISSION FACTORS, SUPPLEMENT 12**
Apr. 1981 192 p refs
(PB82-184722; AP-42-SUPPL-12) Avail: NTIS HC A09/MF A01 CSCL 13B

Revised or updated data are presented for dry cleaning: surface coating; storage of organic liquids; solvent degreasing; graphic arts; consumer/commercial solvent use; sulfuric acid; beer making; ammonium sulfate; primary aluminum; secondary aluminum; gray iron foundries; steel foundries; secondary zinc; asphaltic concrete; asphalt roofing; NEDS source classification codes and emission factor listing; and table of lead emission factors. Author

**N83-10656#** Federal Coordinating Council for Science, Engineering and Technology, Washington, D. C.
**NATIONAL MARINE POLLUTION PROGRAM PLAN. FEDERAL PLAN FOR OCEAN POLLUTION RESEARCH, DEVELOPMENT AND MONITORING. FISCAL YEARS, 1981 - 1985**
Sep. 1981 217 p refs
(PB82-218462; NOAA-82042702) Avail: NTIS HC A10/MF A01 CSCL 13B

This plan represents the second biennial milestone in the continuing interagency planning process called for by the National Ocean Pollution Planning Act of 1978. It summarizes accomplishments that have occurred since the first Federal Plan was published in the fall of 1979, describes priorities of future pollution activities and presents a strategy for improving the National Program. This plan identified opportunities for interagency collaboration and cooperation, and points out research area that are worthy of special attention. Specifically, the plan: describes marine pollution areas that are being addressed by Federal activities; within areas of concern identifies research topics that require additional effort, and those that have been adequately addressed; describes the relative importance of research in each area of concern by discussing existing information gaps, potential severity of the pollution problem, and Federally mandated functions; and presents specific recommendations for improving the program by redirecting existing resources toward the most productive and important areas, improving interagency coordination, or anticipating future problem. GRA

**N83-10661#** Maryland Academy of Sciences, Baltimore.
**ENVIRONMENTAL RESEARCH GUIDING COMMITTEE REPORT Annual Report, 1 Jan. - 31 Dec. 1981**
Jan. 1982 53 p
(PB82-220070; PPRP-57) Avail: NTIS HC A04/MF A01 CSCL 13B

Eighteen collections of planted oysters were made from effluent and control stations of two power plant sites in the mid-Atlantic region. A power plant in the middle reaches of a polyhaline salinite regime and a plant in an oligohaline-mesohaline salinity regime on the Potomac River were selected for the study of various aspects of the life history of the oyster and the effects of temperature-salinity interactions in the mid-Atlantic region. Study variables include mortality, shell growth, percent solids and glycogen (condition), timing and level of reproduction and incidence of parasites, commensals and abnormal growths. In addition, comparisons were made with other similar Atlantic and Gulf Coast studies in an attempt to reconcile apparently conflicting data. Input to power plant siting decisions in the Chesapeake Bay area is emphasized. GRA

**N83-10663#** Environmental Protection Agency, Ann Arbor, Mich. Office of Mobile Source Air Pollution Control.
**DETERMINATION OF A RANGE OF CONCERN FOR MOBILE SOURCE EMISSIONS OF HYDROGEN SULFIDE**
Jan. 1982 38 p refs
(PB82-201773; EPA-AA-CTAB-PA-82-7) Avail: NTIS HC A03/MF A01 CSCL 13B

Mathematical models that were designed for various exposure scenarios (such as enclosed spaces, expressways, and street canyons) were used to calculate the ambient air concentrations resulting from various mobile source hydrogen sulfide emission factors (grams/mile). A literature search was conducted to aid in the determination of the final range of concern. The results of this analysis provide a range of concern for ambient hydrogen sulfide concentrations of 0.03 mg/cu m to 14.0 mg/cu m. This corresponds to motor vehicle emission levels of from 10.5 to 4,900 mg/mile to 958.5 to 447,300 mg/mile on the road and 0.04 to 204 mg/min to 3.8 to 1,770 mg/min for garages, depending on the type of scenario chosen to represent public exposure. Under nonmalfunction conditions or when the malfunction does not cause

a rich mixture, high catalyst temperature and low exhaust space velocity, the resulting H2S emissions are negligible (below the range of concern for any scenario). GRA

**N83-10665#** National Academy of Sciences - National Research Council, Washington, D. C. Motor Vehicle Nitrogen Oxides Standard Committee.
**NO SUB X EMISSION CONTROL FOR HEAVY DUTY VEHICLES: TOWARD MEETING A 1986 STANDARD Final Report**
1981 130 p refs
(Contract EPA-68-01-6188)
(PB82-183880; ISBN-0-309-03226-1) Avail: NTIS HC A07/MF A01 CSCL 13B

The technological feasibility of meeting a more stringent standard for nitrogen oxides (NOX) emissions by 1986 was studied. The impact of emission control technologies on the cost, efficiency, and performance of heavy duty engine vehicles and their impact on other potentially hazardous engine emissions was investigated. The scientific, technical, and cost issues raised by NOx emission controls for heavy duty vehicles of model year 1986 are analyzed. Several policy questions arising from the technical findings in this study are noted and it is suggested that these questions be considered in a rulemaking procedure. GRA

**N83-11136#** Rolls-Royce Ltd., Derby (England).
**THE FUEL EFFICIENT JET ENGINE**
D. J. PARFITT 1982 14 p
(PNR-90114) Avail: NTIS HC A02/MF A01

The development of the RB 211 engine modules is described and the ways in which the RB 211 overcomes problems which reduce fuel efficiency are outlined. Low fuel consumption is achieved by keeping installation losses (intake cowl drag, air and power offtakes) low. High component efficiency, with duct losses and leakages from the core engine minimized is sought. The conflict between the high bypass ratio with low maximum cycle temperature for low jet velocity, and high pressure ratio with high maximum cycle temperature for high thermodynamic cycle efficiency, is resolved by running the engine to the highest temperature consistent with achieving an acceptable high pressure turbine blade life. Author (ESA)

**N83-11277#** California Univ., Berkeley. Water Thermal and Chemical Technology Center.
**ASSESSMENT OF HIGH HEAT-TRANSFER EVAPORATORS AS POWER PLAN CONDENSERS TO PRODUCE ABUNDANT FRESHWATER**
A. D. K. LAIRD, J. FRISCH, and E. F. ENSLER 1982 189 p refs
(PB82-198045; OWRT-C-00070-S(0444)(1)) Avail: NTIS HC A09/MF A01 CSCL 07D

Energy requirements to produce abundant freshwater from saline water sources suggests the use of high heat-transfer evaporative condensers in power plants where sufficient waste heat is available for distillation. Review of current existence of such dual-purpose plants as well as a discussion of planning for future designs is presented. Computer programs utilizing available engineering equations and cost analysis for multieffect distillation plants have been developed and are presented with example problems. They are particularly useful for analysis of existing designs, and an additional computer code for optimization of new designs has been developed. The examples show appreciable improvement in lowering unit water cost of the product, as well as adjusting such variables as temperature, mass flow rates and evaporator areas. Preliminary computerized calculations show that a two-effect evaporator unit condensing 7 million pounds per hour of steam from a 1,000 MW power plant would produce 23 million gallons per day of freshwater at a cost of less than $1 per thousand gallons. Author (GRA)

**N83-11591#** Forschungsstelle fuer Energiewirtschaft, Munich (West Germany).
**STUDY OF THE POSSIBILITIES OF MORE RATIONAL USE OF ENERGY IN THE SECTOR OF TRADE AND COMMERCE, PART 2 Final Report, Aug. 1981**
K. F. EBERSBACH, A. FISCHER, G. LAYER, W. STEINBERGER, M. WEGNER, and B. WIESNER Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 175 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-077-PT-2; ISSN-0340-7608) Avail: NTIS HC[en1] A08; Fachinformationszentrum, Karlsruhe, West Germany DM 34

The energy demand in the sector of trade and commerce was registered and analyzed. Measures to improve the energy demand structure are presented. In several typical firms like hotels, office buildings, locksmith's shops, motor vehicle repair shops, butcher's shops, laundries and bakeries, detailed surveys of energy consumption were done and included in a statistic evaluation. Subjects analyzed were: development of the energy supply; technology of energy application; final energy demand broken down into demand for light, power, space heating and process heat as well as the demand for cooling; daily and annual load curves of energy consumption and their dependence on various parameters; and measures to improve the structure of energy demand. Detailed measurement points out negligences in the surveyed firms and shows possibilities for likely energy savings. In addition, standard values for specific energy consumption are obtained.
Author (ESA)

**N83-11592#** Broetje (August) G.m.b.H. und Co., Rastede (West Germany).
**DIESEL DRIVEN LOW CAPACITY HEAT PUMP FOR HEATING AND HOT WATER PRODUCTION Final Report, Jun. 1981**
P. HOEFLER Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 96 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-128; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 20

Heat pumps that reduce primary energy consumption for heating needs when they are driven by an internal combustion motor were studied. The heat produced as well from the heat pump as from the combustion in the diesel motor was used for home heating and hot water preparation. The objective was a 25kW capacity for a one familiy house. Material used should be standard, so a special design diesel motor or heat pump was not considered. An air/water cooled type diesel motor was coupled to a 12kW capacity heat pump for an outdoor temperature of 3 C using R12 freon as refrigerant. Description of all elements is given. Tests were in the laboratory and in a one family house. The expected efficiency factor of 1.34 could not be confirmed and an average annual value of only 1.05 is assumed. The diesel driven heat pump can not produce the energy savings hoped for. Author (ESA)

**N83-11593#** Arbeitsgemeinschaft Ruckelshau K.G. (West Germany).
**ABSORPTION TYPE WATER CHILLER FIRED DIRECTLY BY WASTE HEAT Final Report, Nov. 1981**
K. L. SAUER and K. KALWAR Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 89 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-129; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18

The direct use of waste heat as heating element in a water chiller of the absorption type was studied. The chilled water is used as cooling element in the industrial process, producing the waste heat or for conditioning the workplace or further located places. The heat source is gaseous or liquid. The cooling capacity is in the range from 10 to 120 kW. After reviewing the different absorption systems, LiBr/H20 proved to be the most suitable. The process retained for experimenting was the manufacturing of

synthetic materials polymer industry and was tested in two different factories It is proved that the use of absorption type water chillers is practicable with an efficiency of 10% to 25% of the waste heat energy, but that the existing chillers need extensive conversion for obtaining economical operation when using a low temperature heating source. Author (ESA)

**N83-11594#** Fraunhofer-Inst. fuer Bauphysik, Holtzkirchen (West Germany)
**ECONOMICAL OPTIMIZED THERMAL INSULATION IN BUILDINGS Final Report, May 1981**
H. WERNER Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 232 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-131; ISSN-0340-7608) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 40

A survey of thermal insulation of buildings, related to economical and physical parameters of fuel oil and insulation methods, was conducted. The different parameters influencing energy consumption in buildings, e g., heat flux, heat losses by ventilation, internal heat sources, and effect of Sun radiation, were analyzed. A method for determining energy needs was elaborated. The economical and cost depending factors were reviewed and a method of optimizing cost, interest rates, and writing off rate was established. It is stated that energy conservation and economics of building have to be forseen in the planning phase of construction, that the heat losses by ventilation are a main factor, and that Sun radiation can have a very good influence. Also, the uncertain life of some construction elements makes it difficult to optimize the economic choice. A table reviews the main physical parameters which have a primary importance and the relation to cost of materials and fuel price Author (ESA)

**N83-11597#** Dortmunder Stadtwerke A.G. (West Germany).
**UTILIZATION OF THE WASTE HEAT OF A STEEL WORK Final Report, Jan. 1981**
U. KAIER (KA-Planungsgesellschaft mbH) and W. BREYMAYER (KA-Planungsgesellschaft mbH) Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 159 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-135, ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 32,50

The use of waste heat of a Siemens-Martin furnace for the production of high pressure steam for a brewery and for a domestic heating network was evaluated. A review of the different possible uses of the high pressure steam, e.g , for heating, for electricity generating, or for cooling, and the actual cost of electricity and fuel and of the domestic heating cost of the already existing network, was made. Cost of the production of steam is calculated, and due to the possible breakdown or maintenance stopping of the Siemens-Martin furnace, cost of the equipment of the boiler with oil or gas burners was evaluated It is proved that the economical justification for the use of this waste heat doesn't exist. Author (ESA)

**N83-11604#** Midland-Ross Corp., Toledo, Ohio. Thermal Systems Technical Center.
**ADVANCED REGENERATIVE HEAT RECOVERY SYSTEM Annual Report, 1981**
A. PRASAD and J. K. JASTI 18 Feb 1982 79 p refs
(Contract GRI-5080-342-0394)
(PB82-200650; GRI-80/0115; REPT-1253) Avail: NTIS HC A05/MF A01 CSCL 13B

A regenerative heat recovery system was designed and fabricated to deliver 1500 scfm preheated air to a maximum temperature of 1600 F. Since this system is operating at 2000 F, the internal parts were designed to be fabricated with ceramic materials. This system is also designed to be adaptable to an internal metallic structure to operate in the range of 1100 to 1500 F. A test facility was designed and fabricated to test this system. The test facility is equipped to impose a pressure differential of up to 27 inches of water column in between preheated air and flue gas lines for checking possible leakage through the seals. The preliminary tests conducted on the advanced regenerative heat recovery system indicate the thermal effectiveness in the range of 60% to 70%. Bench scale studies were conducted on various ceramic and gasket materials to identify the proper material to be used in high temperature applications. A market survey was conducted to identify the application areas for this heat recovery system. A cost/benefit analysis showed a payback period of less than one and a half years. Author (GRA)

**N83-11606#** California State Lands Commission, Sacramento.
**GEOTHRMAL RESOURCE DEVELOPMENT FOR DIRECT HEAT APPLICATIONS: THE IMPACT OF REGULATION Final Report**
Mar. 1981 84 p refs
(PB82-208414; CAEC-88; P500-81-015) Avail: NTIS HC A05/MF A01 CSCL 08I

The laws of 17 western states are reviewed. Interviews were conducted in four states with regulators, drillers, and users to determine the economic impact of regulation on development and utilization of geothermal energy for direct heat applications. Four recommendations are made to encourage greater direct heat applications while maintaining reasonable regulation of the drilling and utilization of the resource. Author

**N83-11609#** Science Applications, Inc., La Jolla, Calif.
**COGENERATION ENERGY SYSTEMS ASSESSSMENT. VOLUME 2: TECHNICAL DISCUSSION Final Report, Apr. 1981 - Jan. 1982**
Mar. 1982 252 p refs
(Contract GRI-5081-344-0430)
(PB82-200692; GRI-81/0013.1; SAI-444-82-074-LJ) Avail: NTIS HC A12/MF A01 CSCL 10B

Gas-fueled cogeneration was assessed to identify research and development opportunities and priorities that maximize the benefits of cogeneration to the gas consumer and utilities. The commercial and multi-family residential market sectors ranging in size from 100 kilowatts (kW) to 10 megawatts (MW) were emphasized. Cogeneration that produced mechanical (shaft horsepower) energy as the primary power was excluded. Technical, economic, and market potential for cogeneration systems in the commercial sector was found to exist. The specific results, conclusions, and impacts cited in this report led to the recommendation to pursue three areas of R&D (in order of priority): (1) Prepackaged, pre-engineered systems; (2) Analyses of--the over-100 kW market and technology, the potential for cogeneration at specific sites in specific utility service territories, cogeneration system reliability, characterization of the light industrial market; (3) Technology development (several specific areas). Author (GRA)

**N83-11611#** Committee on Merchant Marine and Fisheries (U. S. House).
**ACID RAIN: CZMA**
Washington GPO 1982 278 p refs Hearings on H.R. 4597 before the Subcomm. on Oceanog. of the Comm on Merchant Marine and Fisheries, 97th Congr., 1st Sess., 19 Jun., 16 Sep., 29 Oct , and 19 Nov. 1981
(GPO-91-371) Avail. Subcommittee on Oceanography

The effects of acid rain on the environment are discussed Regulations for its control are debated. The regulation of oil exploration on the continental shelves is discussed. RJF

**N83-11617#** Bergbau-Forschung G.m.b.H., Essen (West Germany). Abt. Physikalische Chemie.
**LABORATORY RESEARCH FOR DESULFURIZING AND NO-REDUCTION BY ADDITION OF AMMONIA UNDER THE CONDITIONS OF THE BERGBAU-FORSCHUNG FLUE GAS DESULFURIZING PROCESS Final Report, Dec. 1980**
E. RICHTER, H. J SCHMIDT, and J. JUNG Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 83 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-147; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18

Laboratory tests were conducted for improving the catalytic efficiency of charcoal and for improving the thermal regeneration of the activated carbon. The injection of ammonia enhances SO2 removal. At high SO2 concentrations, the reduction of NO components is limited. The reduction yield is increased at higher temperatures or in a two stage moving bed reactor, using active coal. In the first bed, mainly sulfur oxides are removed. Upstream from the second bed NH3 is injected. In this way over 99% of SO2 and over 80% of NO components can be removed. This was obtained at temperatures ranging from 120 to 150 C. In this process, SO2 and NO components can be removed both without a modification of the boiler plant and without reheating of the flue gases. Impregnation of the active coal with metal compounds did not increase the catalytic activity The mechanisms of the reactions, occuring during thermal regeneration of the active charcoal, were found. Author (ESA)

**N83-11631#** *AeroVironment, Inc., Pasadena, Calif.*
**SOUTHERN CALIFORNIA OFFSHORE AIR QUALITY MODEL VALIDATION STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Report**
P. ZANNETTI, D. M. WILBUR, and R. A. BAXTER Nov. 1981 11 p refs 4 Vol.
(Contract DI-AA851-CT0-56)
(PB82-190711; AV-FR-81/559-VOL-1; BLM/YV/SR-81/07-VOL-1) Avail: NTIS HC A02/MF A01 CSCL 13B

Models used to predict onshore air quality impacts from outer continental shelf (OCS) emission sources were validated. Field experiments and computer modeling analysis were used to give a better understanding of dispersion over water and at the land/sea interface In the field experiments performed, a tracer gas (SF6) was released from the research vessel RV/Acania, anchored offshore, with tracer gas samples collected downwind at the surface and aloft, both offshore and onshore. Ambient tracer gas concentrations were measured horizontally (across-wind) and vertically at each of the downwind distances. To determine offshoe gas concentration, repeated syringe 'grab' samples were taken (for later analysis) from a boat at the surface and a continuous tracer gas analyzer was operated in an airplane aloft. To determine tracer gas concentrations onshore at the surface, hourly-averaged syringe samples and repeated syringe 'grab' samples were taken (for later analysis), while another continuous tracer gas analyzer operated in a mobile van and the airplane made transects aloft. GRA

**N83-11632#** AeroVironment, Inc., Pasadena, Calif.
**SOUTHERN CALIFORNIA OFFSHORE AIR QUALITY MODEL VALIDATION STUDY. VOLUME 2: SYNTHESIS OF FINDINGS Final Report**
P. ZANNETTI, D. M. WILBUR, and R. A. BAXTER Nov. 1981 8 p refs 4 Vol.
(Contract DI-AA851-CT0-56)
(PB82-190729; AV-FR-81/559-VOL-2; BLM/YN/SR-81/08-VOL-2) Avail: NTIS HC A02/MF A01 CSCL 13B

Models commonly used in predicting onshore air quality impacts of OCS emission sources were validated. Field tests and analyses were performed to modify and validate the dispersion aspects of Gaussian and trajectory models. GRA

**N83-11633#** National Academy of Sciences - National Research Council, Washington, D. C. Polar Research Board.
**ARCTIC TERRESTRIAL ENVIRONMENTAL RESEARCH PROGRAMS OF THE OFFICE OF ENERGY RESEARCH, DEPARTMENT OF ENERGY: EVALUATION AND RECOMMENDATIONS. APPENDIX A: TERRESTRIAL ENVIRONMENTAL RESEARCH IN ALASKA DURING 1980-1981**
J. R. HAUGH 1981 224 p refs
(Contract DE-AC01-BOEV-1C453)
(PB82-197096) Avail: NTIS HC A10/MF A01 CSCL 13B

A review of ongoing and planned Arctic terrestrial environmental research in Alaska is provided. The goals, philosophies, and directions of research agencies are reviewed. The financial support provided for Arctic terrestrial environmental research is also reviewed. Author (GRA)

**N83-11634#** *National Academy of Sciences - National Research* Council, Washington, D. C. Polar Research Board
**ARTIC TERRESTRIAL ENVIRONMENT RESEARCH PROGRAMS OF THE OFFICE OF ENERGY RESEARCH, DEPARTMENT OF ENERGY: EVALUATION AND RECOMMENDATIONS**
1982 80 p refs
(Contract DE-AC01-BOEV-1C453)
(PB82-197088) Avail: NTIS HC A05/MF A01 CSCL 13B

Possible energy related developments in the Arctic are considered. Environmental research related to these activities and a framework for future research are discussed. Up to 50% of the recoverable oil remaining within U.S. jurisdiction may occur in the Arctic, and coal deposits are perhaps equal to those in the continental U.s However, almost none of the infrastructures of economically developed areas exist, such as communities, roads, refineries, water and waste facilities, and transportation corridors. Integrated ecological studies centered on at least one intensive research site or landscape unit either in the tundra or the taiga or in an area containing both are among the recommendations. Author (GRA)

**N83-11887#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abteilung Flugverkehrswissenschaft.
**THE MODAL SPLIT IN THE JAPANESE PASSENGER TRANSPORTATION SYSTEM**
D. EBERLEIN Jan. 1982 52 p refs In GERMAN; ENGLISH summary
(DFVLR-FB-82-09) Avail: NTIS HC A03/MF A01; DFVLR, Cologne DM 16,70

The modal split in the Japanese long-distance passenger transportation system as well as its reasons and impacts are examined. Competition between automobile and train, and between train and airplane, are analyzed. Results show that the competition in Japan is completely different from that in other industrialized countries by reason of the high performance railway network. The secondary impacts are explained with respect to energy consumption and traffic accidents. Transportation demand development in comparison with Germany is described. Author (ESA)

**N83-12094*#** *General Electric Co., Evendale, Ohio. Aircraft* Engine Group.
**ENERGY EFFICIENT ENGINE. FLIGHT PROPULSION SYSTEM PRELIMINARY ANALYSIS AND DESIGN Report, Jan. 1978 - Nov. 1979**
R. P. JOHNSTON Nov. 1979 50 p refs
(Contract NAS3-20643)
(NASA-CR-159859; NAS 1.26:159859; R80AEG396) Avail: NTIS HC A03/MF A01 CSCL 21E

The characteristics of an advanced Flight Propulsion System (FPS) suitable for introduction in the late 1980's to early 1990's, were defined. It was determined that NASA goals for efficiency, environmental considerations, and economics could be met or exceeded with the possible exception of NOx emission. In evaluating the FPS, all aspects were considered including component design, performance, weight, initial cost, maintenance

cost, engine-system integration (including nacelle), and aircraft integration considerations. In terms of the NASA goals, the current FPS installed specific fuel consumption was reduced 14.2% from that of the CF6-50C reference engine. When integrated into an advanced, subsonic, study transport, the FPS produced a fuel-burn savings of 15 to 23% and a direct operating cost reduction of 5 to 12% depending on the mission and study-aircraft characteristics relative to the reference engine. J.M.S.

**N83-12285#** Moreland Associates, Fort Worth, Tex.
**EARTH-COVERED BUILDINGS: AN EXPLORATORY ANALYSIS FOR HAZARD AND ENERGY PERFORMANCE Final Report, Sep. 1979 - Nov. 1981**
F. L. MORELAND Nov. 1981 314 p
(PB82-189564; MAI-81) Avail. NTIS HC A14/MF A01 CSCL 13M

The performance of earth covered buildings is examined regarding storms, nuclear detonations, earthquakes, fire, nuclear radiation, energy consumption, compatibility with solar energy systems, peak load effects, soil and groundwater effects, air and climate effects, occupant evaluation, and resource management. Potential longterm benefits are assessed, including the areas of economic benefits, community benefits and security benefits. GRA

**N83-12521#** Committee on Governmental Affairs (U. S. Senate).
**ENERGY CONSERVATION STRATEGY FOR THE 1980'S**
Washington GPO 1982 202 p refs Hearing before the Subcomm. on Energy, Nucl. Proliferation and Govt. Process. of the Comm. on Govt. Affairs, 97th Congr., 1st Sess., 21 Jul. 1981
(GPO-86-217) Avail: Subcommittee on Energy, Nuclear Proliferation and Government Processes

The energy conservation strategy is discussed. The level of oil imports is considered. S L.

**N83-12536#** Technical Univ. of Denmark, Lyngby.
**USERS EXPERIENCE IN DENMARK: DEVELOPMENTS, ACHIEVEMENTS AND EXPERIENCE OF THE DANISH ACTIVITIES IN WIND ENERGY UTILIZATION, 1974 - 1981**
B. M. PEDERSEN *In* Von Karman Inst. for Fluid Dyn. Wind Energy Conversion Devices 11 p 1981
Avail: NTIS HC A17/MF A01

Denmark initiated activities to investigate the possibility of using wind energy as a supplement to the electricity supply This would eventually alleviate the burden of increasing prices of fossil fuel and also add to the security of supply of energy to the nation. The activities followed two main streams. A governmental R&D programme was formulated and implemented, whereas at the same time private industry embarked on the development of small scale wind energy converting systems (SWECS) for the private user. Two large scale (630 kW) demonstration wind turbines were completed and are now in fully automatic operation. More than 400 SWECS were put into operation, most of them producing electricity for the owners own use but selling surplus power to the utilities. Author

**N83-12542#** Cook Inlet Region, Inc., San Francisco, Calif.
**COAL TO METHANOL FEASIBLITY STUDY: BELUGA METHANOL PROJECT. VOLUME 4: ENVIRONMENTAL Final Report**
Sep. 1981 472 p refs Prepared in cooperation with Placer Amex, Inc., San Francisco
(Contract DE-FG01-80RA-50299)
(DE82-006057; DOE/RA-50299-1119-VOL-4) Avail: NTIS HC A20/MF A01

The major environmental issues relevant to development of a coal gasification and methanol fuels production facility and related coal mining activities and transportation systems in the west Cook Inlet area, Alaska were assessed. An extensive review into existing information on the Beluga region of west Cook Inlet was conducted and updated with the findings of land resource projects. Specific field activities then were initiated to expand the environmental data base in areas relevant to this project where there was a paucity of information. Based on these findings the project was reviewed in detail to identify significant environmental issues and to outline the state and federal permit requirements to ensure that these element are an integral component of all subsequent project planning and management decisions. DOE

**N83-12544#** Hawaii State Dept. of Planning and Economic Development, Honolulu.
**GEOTHERMAL POWER DEVELOPMENT IN HAWAII. VOLUME 1. REVIEW AND ANALYSIS**
Jun. 1982 134 p refs 2 Vol.
(Contract DE-FC03-79ET-27133)
(DE82-020077; DOE/ET-27133-T2-VOL-1) Avail: NTIS HC A07/MF A01

The history of geothermal exploration in Hawaii is reviewed briefly. The nature and occurrences of geothermal resources are presented island by island. An overview of geothermal markets is presented. Other topics covered are: potential markets of the identified geothermal areas, well drilling technology, hydrothermal fluid transport, overland and submarine electrical transmission, community aspects of geothermal development, legal and policy issues associated with mineral and land ownership, logistics and infrastructure, legislation and permitting, land use controls, Regulation 8, public utilities commission, political climate and environment, state plans, county plans, geothermal development risks, and business planning guidelines. DOE

**N83-12559#** Energy Utilization Systems, Inc., Pittsburgh, Pa.
**THE 1980 SURVEY AND EVALUATION OF UTILITY CONSERVATION, LOAD MANAGEMENT, AND SOLAR END-USE PROJECTS. VOLUME 3. UTILITY LOAD MANAGEMENT PROJECT Final Report**
R. P. BLEVINS Jan. 1982 344 p refs Sponsored in part by ORNL
(Contract W-7405-ENG-26; EPRI PROJ. 1940-1)
(DE82-007247; EPRI-EM-2193-VOL-3) Avail: NTIS HC A15/MF A01

The results of the 1980 survey of electric utility-sponsored energy conservation, load management, and end-use solar energy conversion projects are described. The work is an expansion of a previous survey and evaluation. There are three volumes and a summary document. Each volume presents the results of an extensive survey to determine electric utility involvement in customer-side projects related to the particular technology (i.e., conservation, solar, or load management), selected descriptions of utility projects and results, and first-level technical, and economic evaluations. DOE

**N83-12580#** One America, Inc., Washington, D.C.
**QUESTIONS AND ANSWERS ABOUT ENERGY RECOVERY FROM WASTE**
Washington DOE Sep. 1982 29 p refs
(Contract DE-AC01-80CS-24312)
(DE82-022154; DOE/CS-24312/4) Avail: NTIS HC A03/MF A01

Questions and answers about the developing waste-to-energy industry are presented. They are intended as a ready reference for the general public and others interested in exploring the option of utilizing municipal waste as a renewable energy resource. Questions were researched and answered in six broad categories: general information; state-of-the-art; economics/financial; environmental; institutional; and project implementation. DOE

**N83-12581#** Department of Energy, Washington, D. C. Office of the Secretary.
**SECRETARY'S REPORT TO CONGRESS. SECRETARY'S STATEMENT, PROGRAM REVIEW AND OUTLOOK Annual Report**
Aug. 1982 176 p
(DE82-021878; DOE/S-0010-82) Avail: NTIS HC A09/MF A01

All elements of the Department of Energy are discussed. Three annexes are included: the Fifth Report to Congress -

Comprehensive Program and Plan for Federal Energy Education, Extension, and Information Activities (Published December 1981 by the Office of State and Local Programs, Office of Conservation and Renewable Energy, US Department of Energy); Third Annual Report to Congress on the Automotive Technology Development Program (Published February 16, 1982, by the Office of Vehicle and Engine Research and Development, Office of Conservation and Renewable Energy,US Department of Energy); and Observations and Recommendations on the Future of the Energy Extension Service Program; Fourth Report by the National Energy Extension Service Advisory Board (Published January 182 by the Office of State and Local Programs, Office of Conservation and Renewable Energy, US Department of Energy). DOE

**N83-12590#** Energy and Environmental Analysis, Inc., Arlington, Va.
**INDUSTRIAL ENERGY USE, ANNUAL REPORT FOR 1979 - 1980 Final Report**
M O. LERNER, V. S. KOTHARI, A. SARIN, D C. HAUTH, and C. P. KAPLAN 20 Jan. 1982 121 p refs
*(Contract GRI-5014-342-0185)*
(PB82-200585; GRI-79/01031) Avail: NTIS HC A06/MF A01 CSCL 10A

*Results of a study covering major energy-intensive industries* to identify areas with high potentials for improvement in the efficiency of industrial gas use are given. About 85 percent of all natural gas used in industrial process heaters is accounted for in the seven industries which are primary metals (iron and steel, aluminum), stone, clay and glass, petroleum, chemicals, food, textiles, and paper. The study proceeded in four major steps. In step 1, the most recent industrial fuel use data was collected, checked, and disaggregated by process, furnace, and fuel type using five national energy consumption data bases. In Step 2, efficiency and heat distribution for 40 furnaces were determined using energy and material balances. In Step 3, discussions were held with industry representatives to obtain feedback on the study's findings relating to current and future uses of alternate energy sources and promising conservation options which are available or under development. In Step 4, quantitative data on total energy use and typical furnace efficiency were incorporated with qualitative information on future fuel use trends, future changes in process/furnace mix, etc., to identify areas where maximum gains in energy efficiency could occur. GRA

**N83-12591#** Massachusetts Inst. of Tech., Cambridge. Energy Lab.
**A REVIEW OF THE ENERGY PRODUCTIVITY CENTER'S LEAST COST ENERGY STRATEGY STUDY Final Report**
D. O. WOOD, M. MANOVE, and E. R. BERNDT Nov. 1981 246 p refs Revised Sponsored by Electric Power Research Inst.
(PB82-188111; MIT/EL-81-043) Avail: NTIS HC A11/MF A01 CSCL 10A

Ways the nation would have provided energy services if its capital stock had been reconfigured to be optimal for actual 1978 *energy prices were studied. It is concluded that if the 1978 capital* stock had been transformed in conformance with a least-cost principal for providing energy services, per capital energy services *would have been reduced by 17%.* Author (GRA)

**N83-12593#** Energy and Environmental Analysis, Inc., Arlington, Va.
**INDUSTRIAL ENERGY USE, VOLUME 2 Final Report, Jul. 1979 - Apr. 1981**
M. O. LERNER, A. SARIN, and V. S. KOTHARI Jan. 1982 285 p refs Sponsored by Gas Research Inst.
(PB82-200593; GRI-79/0103.2) Avail: NTIS HC A13/MF A01 CSCL 10A

The results of a study covering seven major energy-intensive industries to identify areas with high potential for improvement in the efficiency of industrial gas use are given. The industries studied include primary metals (iron and steel, aluminum); stone, clay, and glass; petroleum; chemicals; food; textiles; and paper. GRA

**N83-12594** British Library Lending Div., Boston Spa (England).
**POPULATION HAZARDS RESULTING FROM THE COMBUSTION OF FOSSIL FUELS AND THE NUCLEAR POWER INDUSTRY**
Z. JAWOROWSKI 9 Sep. 1982 17 p refs Transl. into ENGLISH from Post. Fiz. Med. (Poland), v. 10, no. 1-2, 1975 p 149-154
(BLL-RISLEY-TR-4173-(9091.9F)) Avail: British Library Lending Div., Boston Spa, Engl.

The building of nuclear power stations into existing power industry systems, is frequently met with negative public opinion as well as administrative opposition resulting from distrust of this new source of energy. The biological damage to the population resulting from nuclear energy sources and those injuries resulting from so called conventional power stations based on fossil fuel are compared. It is suggested that nuclear power stations and the effects of industrial activities associated with them (uranium mines, fuel production and processing plants), impairment of the health of the population living in their vicinity may result primarily from the radionuclides released into the environment near these installations. It is concluded that conventional power stations expose the population to hazards of large quantities of dusts and chemical compounds, the adverse effects of which are incomparably greater than the radiation effects of power stations of both types. E.A.K.

**N83-12630#** Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
**BACKGROUND LEVELS AND ENVIRONMENTAL CYCLING OF PETROLEUM HYDROCARBONS: MULTIMEDIA MONITORING REQUIREMENTS**
E. M. LEVY *In* WMO On the Develop. of Multimedia Monitoring of Environ Pollution p 325-351 1980 refs
Avail: NTIS MF A01; print copy available at WMO, Geneva

The cycling of petroleum in the environment is discussed and the present state of knowledge concerning the distribution of petroleum pollution in the marine atmosphere, on the surface of the ocean, in the water column, and in marine organisms and sediments is reviewed. Measurements of concentrations of petroleum in the surface microlayer are presented. Tar distributions are highly variable with insufficient sampling preventing generalization. Observations of dissolved or dispersed petroleum residues suggest that there is a background of a few micrograms per liter over much of the Atlantic, Pacific and Indian oceans, with somewhat higher concentrations in the Mediterranean and Baltic seas. Distributions of hydrocarbons in marine organisms are difficult to determine since some organisms produce n-paraffins naturally. Author (ESA)

**N83-12659#** Massachusetts Inst. of Tech., Cambridge.
**SCALE EFFECTS IN LIQUEFIED FUEL VAPOR DISPERSION Final Technical Report**
J. A. FAY and D. RANCK Dec. 1981 100 p refs
(Contract DE-AS02-77EV-04204)
(DE82-006198; DOE/EP-0032) Avail: NTIS HC A05/MF A01

Vapor clouds formed by rapid boiling of liquefied gas spilled on land or water exhibit unusual dispersive behavior caused by physical phenomena which are not yet adequately understood. To help elucidate these phenomena this study proposes a method for correlating observations made in disparate field and wind tunnel experiments and, using this methodology, compares all available test data. The bases of the method are a nondimensionalizing of the principle experimental observables and test parameters through use of atmospheric flow parameters and initial cloud properties and the use of a simple entrainment model to simplify the expected relationships among the observed quantities. Peak cloud concentration, travel time and distance are the observables used in this analysis. A good correlation was found in tests of isothermal clouds on level surfaces, but many tests are required to establish average cloud behavior. In tests on sloping ground, cloud drift time and distance were altered but the dilution rate was unaffected. DOE

**N83-12665#** Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
**THE BEHAVIOR OF LNG VAPOR CLOUDS: WIND-TUNNEL SIMULATION OF 40 M3 LNG SPILL TESTS AT CHINA LAKE NAVAL WEAPONS CENTER, CALIFORNIA Final Report, Jul. 1979 - Jul. 1981**
D. E. NEFF and R. N MERONEY Jul 1981 172 p refs
(PB82-199027; CER81-82DEN-RNM1; GRI-80/0094) Avail. NTIS HC A08/MF A01 CSCL 13B

Wind tunnel transient concentration data were obtained from modelling tests which reproduced gaseous dispersion from five different forty cubic meter or less liquefied natural gas (LNG) spills performed at China Lake Naval Weapons Center during the spring and summer of 1980 Comparisons in the transient concentration data between these modeled tests and the field tests indicated which parameters are dominant in the modelling process Model tests which reproduced the wind shear and turbulence structure of the approach wind reproduced the concentration patterns measured at the field site. This result reinforced the predictive reliability of wind tunnel modeling of larger volume spills. GRA

**N83-12666#** Colorado State Univ, Fort Collins. Dept. of Civil Engineering.
**LNG PLUME INTERACTION WITH SURFACE OBSTACLES Final Report, Sep. 1980 - Sep. 1982**
K. M. KOTHARI, R. N. MERONEY, and D. E. NEFF Sep 1981 154 p refs
(Contract GRI-5014-352-0203)
(PB82-198995; GRI-80/0095; CER81-82KMK-RNM-DEN22)
Avail. NTIS HC A08/MF A01 CSCL 13B

A wind-tunnel test program was conducted on a 1:250 scale model to determine the effects of surface obstacles on the dispersion of LNG and neutral density plumes. The tests were conducted with continuous LNG boiloff rate of 30 cu m/min, 4 and 7 m/sec wind speeds and 21 different sets of surface obstacle configurations. Plots of ground-level concentration (mean and peak) contours were constructed. The highest concentrations were observed without any surface obstacles In general, the lower speed resulted in higher ground-level concentration when the surface obstacle interacted with the plume. The mean concentration measured with neutral density plume was about three to five times smaller in magnitude than those observed with the LNG plume. The measured concentration for LNG plumes tended to have its maximum off the centerline. The addition of smaller buildings gave only slight reduction in the LFL distances. The simulated tree line resulted in approximately the same concentration parallel to the tree line Author (GRA)

**N83-12668#** Radian Corp, Durham, N.C
**MECHANISMS OF DRY SO2 CONTROL PROCESSES Final Report, Sep. 1980 - Sep. 1981**
C. APPLE and M. E. KELLY Apr. 1982 137 p refs
(Contract EPA-68-02-3171)
(PB82-196924; EPA-600/7-82-026) Avail. NTIS HC A07/MF A01 CSCL 13B

Physical and chemical processes and reaction mechanisms for lime spray drying and dry injection of sodium compounds in dry flue gas desulfurization (FGD) processes are discussed. Chemical reactions, physical changes, proposed reaction mechanisms and mathematical models, process parameters affecting reactions and their rate, and data needed to verify proposed reaction mechanisms and models are includes. Published technical papers were the primary reference sources Coal-fired boiler dry FGD applications are emphasized. Lime spray drying reactions are primarily gas/liquid-phase reactions, with SO2 removal depending on moisture in the lime slurry droplet. Initially, the moisture content is high, and the reaction rate is controlled by diffusion of SO2 to the droplet surface; most SO2 removal occurs during this phase. As evaporation reduces the moisture, the dissolution of Ca(OH)2 into ions limits the SO2 removal rate. Later, the precipitation of $CaSO3+1/2\ H2O$ onto the surface of the lime particles retards diffusion of SO2 to the unreacted sorbent. Injecting sodium compound powders into flue gas removes SO2 via gas/solid reactions. First, NaHCO3 is thermally decomposed to Na2CO3 (small pores in the sorbent particles increase the particles' surface area and reactivity). Then the SO2 reacts with Na2CO3 to form Na2SO3, starting at the particle surface. Author (GRA)

**N83-12672#** National Academy of Sciences - National Research Council, Washington, D. C. Committee on the Atmosphere and the Biosphere Board on Agriculture and Renewable Resources.
**ATMOSPHERE-BIOSPHERE INTERACTIONS: TOWARD A BETTER UNDERSTANDING OF THE ECOLOGICAL CONSEQUENCES OF FOSSIL FUEL COMBUSTION Final Report, 15 Sep. 1978 - 31 Aug. 1981**
1981 278 p refs
(PB82-182098) Avail: NTIS HC A13/MF A01 CSCL 06F

The pollutants sulfur and nitrogen compounds, trace metals, and organic substances were examined. It was noted that understanding of patterns of emission, transport, deposition, and biological effects of these pollutants is incomplete. Atmospheric transport and deposition processes and biological accumulation are described. A guide was developed to predict consequences of continued or accelerated pollution, and effects of acid rain were reported. It is concluded that increased scientific effort is needed in two critical areas: long term monitoring and forecasting of future effects of these pollutants, and ecotoxicology. GRA

**N83-13217#** American Gas Association Labs., Cleveland, Ohio.
**COMMERCIALIZATION OF A PULSE COMBUSTION FURNACE WITH ULTRAHIGH EFFICIENCY Final Annual Report, Jan. - Dec. 1980**
F. E. BELLES and J. C. GRIFFITHS Chicago GRI Feb. 1982 79 p
(Contract GRI-5014-341-0112)
(PB82-243809; GRI-80/0131) Avail: NTIS HC A05/MF A01 CSCL 13M

The development of pulse combustion technology, with specific application to furnaces with ultrahigh efficiency is discussed. A nationwide field test of 10 prototype pulse combustion furnaces was conducted which indicated savings ranging from 13 to 46 percent over conventional furnaces alternately operated with the pulse furnaces at the sites for comparison purposes. GRA

**N83-13270#** Office of Technology Assessment, Washington, D.C.
**INCREASED AUTOMOBILE FUEL EFFICIENCY AND SYNTHETIC FUELS. ALTERNATIVES FOR REDUCING OIL IMPORTS Summary Report**
Sep. 1982 39 p refs
(OTA-E-186) Avail: NTIS HC A03/MF A01; HC also available from SOD

Increased automobile fuel efficiency and synthetic fuels production with respect to their potential to reduce conventional oil consumption, and their costs and impacts are assessed. Conservation and fuel switching as a means of reducing stationary oil uses are also considered. S.L.

**N83-13402#** Carrier Corp., Syracuse, N.Y.
**NORTHERN-CLIMATE HEAT-PUMP FIELD PERFORMANCE EVALUATION Final Report**
W. R. READY and C E. BULLOCK Jul. 1982 86 p refs Sponsored by Electric Power Research Inst.
(Contract EPRI PROJ. 789-1)
(DE82-905832; EPRI-EM-2319) Avail: NTIS HC A05/MF A01

The field data and related analysis for four residential and one commercial heat pump installation are presented. Results that cover both heating and cooling operation are presented for an initial period of one year. Additional results reflecting changes in heat pump equipment and controls are presented for selected sites. The building structures, the associated heat pumps, and the instrumentation system used to record the performance data are described. DOE

**N83-13465#** Argonne National Lab., Ill.
**VEHICLE CHARACTERIZATION FOR THE TAPCUT PROJECT: PERFORMANCE AND COST**
C. L. HUDSON, E. S. PUTNAM, and M. J. BERNARD Nov. 1981 143 p refs
(Contract W-31-109-ENG-38)
(DE82-019772; ANX/EES-TM-171) Avail: NTIS HC A07/MF A01

Three sets of technologies for urban transportation for use in testing energy conservation strategies were developed. Each set included both personal and mass transportation vehicles; different socioeconomic conditions were assumed for each of the three sets. Vehicles in the first set combine the best performance and fuel economy characteristics while meeting stringent air emissions standards. Personal vehicles in the second set sacrifice performance for maximum fuel economy. Vehicles in the third set are more fuel efficient than 1980 vehicles but do not represent significant technological improvements from present vehicles. A forecasting vehicle characteristics method data for performance, fuel economy, and purchase price for each vehicle are presented. New engine technologies were introduced in every set, including diesel, Stirling, and Brayton engines, stratified charge Otto engines, and electric and hybrid vehicles. Technology development for transit vehicles paralleled that of autos. DOE

**N83-13516#** Oak Ridge National Lab., Tenn.
**BIOMEDICAL AND ENVIRONMENTAL SCIENCES PROGRAMS AT THE OAK RIDGE NATIONAL LABORATORY**
E. L. PRESTON, comp. and J. A. GETSI, comp. Jul. 1982 69 p
(Contract W-7405-ENG-26)
(DE82-019897; ORNL/TM-8448) Avail: NTIS HC A04/MF A01

A major objective of the biomedical and environmental sciences research at the Oak Ridge National Laboratory is to provide information on environmental, health, and safety considerations that can be used in the formulation and implementation of energy technology decisions. Research is directed at securing information required for an understanding of both the short- and long-term consequences of the processes involved in new energy technologies. Investigation of the mechanisms responsible for biological and ecological damage caused by substances associated with energy production and of repair mechanisms is a necessary component of this research. The research is carried out by the staff of four divisions and one program: Biology Division, Environmental Sciences Division, Health and Safety Research Division, Information Division, and the Life Sciences Synthetic Fuels Program. Research programs underway in each of these divisions are discussed. Information on the following subjects is also included: interactions with universities; interactions with industry; technology transfer; recent accomplishments in the areas of program, publications, awards, and patents; and new initiatives. DOE

**N83-13584#** Office of Technology Assessment, Washington, D.C.
**TECHNOLOGY AND SOVIET ENERGY AVAILABILITY: SUMMARY**
Nov. 1981 27 p refs
(OTA-ISC-154) Avail: NTIS HC A03/MF A01

The course Soviet energy production will take if present policies in the West and the USSR remain unchanged is investigated. Opportunities and problems in the five primary Soviet energy industries: oil, gas, coal, nuclear, and electric power; equipment and technology requirements; and the implications of providing or withholding assistance are addressed. N.W.

**N83-13587*#** National Aeronautics and Space Administration, Washington, D. C.
**SECOND PROGRAM ON ENERGY RESEARCH AND TECHNOLOGIES**
Oct. 1982 117 p Transl. into ENGLISH of "Zweites Programm Energieforschung und Energietechnologien" rept. Germany Ministry for Research and Technology, Bonn, 1982 p i-iv, 1-122 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASW-3541)
(NASA-TM-77154; NAS 1.15:77154) Avail: NTIS HC A06/MF A01 CSCL 10B

The second major energy research and development program is described. Renewable and nonrenewable energy resources are presented which include nuclear technology and future energy sources, like fusion. The current status and outlook for future progress are given. E.A.K.

**N83-13594#** National Bureau of Standards, Washington, D.C.
**TI-59 PROGRAM FOR CALCULATING THE ANNUAL ENERGY REQUIREMENTS FOR RESIDENTIAL HEATING AND COOLING. VOLUME 1: USERS MANUAL**
F. A. COSTELLO, T. KUSUDA, and S. ASO Jul. 1982 132 p 2 Vol.
(Contract DE-AD01-76PR-06010)
(DE82-010174; DOE/NBB-0011-VOL-1) Avail: NTIS HC A07/Mf A01

The program documentation and user's manual for the TI-59 pocket calculator program for determining annual heating and cooling energy consumption of residential buildings are given. The program embodies the Variable-Base-Degree-Day Method, which was proven to yield equivalent results as obtained by the comprehensive hour-by-hour simulation calculation, such as DOE-2. Given are step-by-step calculation procedure information on input data, sample calculations, and mathematical basis of the procedure DOE

**N83-13595#** National Bureau of Standards, Washington, D.C.
**TI-59 PROGRAM FOR CALCULATING THE ANNUAL ENERGY REQUIREMENTS FOR RESIDENTIAL HEATING AND COOLING. VOLUME 2: PROGRAM REFERENCE MANUAL**
T. KUSUDA, F. A. COSTELLO, S. T. LIU, and J. P. BARNETT Jul. 1982 235 p 2 Vol.
(Contract DE-AI01-76PR-06010)
(DE82-020275; DOE/NBB-0011-VOL-2) Avail: NTIS HC A11/MF A01

Basic mathematical formulation, program listing, and input data for the subject pocket calculator energy analysis procedure are given. The data include solar and surface weather parameters, degree-days to variable bases, sunlit factors and Earth temperature. DOE

**N83-13598#** Allen (Eliot) and Associates, Inc., Salem, Oreg.
**GUIDE TO A GEOTHERMAL HEAT PLAN: A GEOTHERMAL ENERGY APPLICATION, SERIAL NO. 3**
Mar. 1982 39 p refs Sponsored in cooperation with Oregon Dept. of Energy Prepared for Washington State Energy Office, Olympia
(Contract DE-FG07-79RO-00079; DE-FG51-79RO-00079)
(DE82-020591; WAOENG-82-04) Avail: NTIS HC A03/MF A01

An atlas systematically monitors a community's thermal supplies and demands, and catalogs them in the same manner as other community development sectors. The heat plan contains thermal goals and implementation measures based on conditions and opportunities revealed in the atlas. The heat demands considered in the atlas include space, water, and industrial process heat demands. Thermal resources considered include those conventional fuels already in use, as well as those alternate energy resources which have potential for utilization. (LEW) DOE

## 01 ENERGY POLICIES AND ENERGY SYSTEMS ANALYSIS

**N83-13606#** Hittman Associates, Inc., Columbia, Md.
**EVALUATION OF ESTIMATED ENERGY CONSERVATION MEASURE COSTS AND BENEFITS IN THE RESIDENTIAL MULTIFAMILY SECTOR Final Report**
Sep. 1982 119 p refs
(Contract DE-AC01-79PE-70044)
(DE82-000490; DOE/PE-70044/T5) Avail: NTIS HC A06/MF A01

Supporting data for a policy review to determine how the multifamily buildings subsector is responding to market signals was sought. What role, if any, the federal government should play in encouraging conservation in multifamily buildings is discussed. The policy review seeks to develop an understanding of the current level of and trends in energy conservation activity in multifamily housing. The availability of the required data is determined and information in a form which facilitates its use by policy analysts is compiled. The results are presented in four parts. Part I provides an overview. Part II presents, in tabular form, the cost of selected retrofit items and the resulting energy and cost savings. As an aid to understanding the data in Part II, the salient assumptions underlying the data are also included in this part. Part III describes how the data in Part II were developed. DOE

**N83-13613#** California Univ., Berkeley. Lawrence Berkeley Lab. Energy Performance of Buildings Group.
**COMPUTERIZED INSTRUMENTED RESIDENTIAL AUDIT, VERSION 1.0. SOURCE LISTINGS**
Jun. 1982 183 p
(Contract DE-AC03-76SF-00098)
(DE82-019953; LBL-PUB-448) Avail: NTIS HC A09/MF A01

The CIRA is a set of computer programs to predict the energy consumption of small buildings. It also provides an optimized list of improvements which reduce energy use. The source code in BASIC is provided to help a user adapt the program to a particular application, or to see details of the calculation algorithms. DOE

**N83-13614#** California Univ., Berkeley. Dept. of Nuclear Engineering.
**USE OF WASTE HEAT IN DISTRICT SYSTEMS WITH CONSIDERATIONS OF SEASONAL-HEAT-DEMAND VARIATIONS**
R. T. MAHINI and V. E. SCHROCK Jun. 1982 116 p refs
(Contract DE-AT03-79ET-15391)
(DE82-019923; UCB-NE-4022) Avail: NTIS HC A06/MF A01

The use of waste heat in district heating systems and considerations of seasonal heat demand variations were studied. The system employs heat pumps stationed throughout an urban center to use the waste heat from a power plant condenser coolant as their heat source and to deliver hot water in the consumer pipe line. The water from the power plant is circulated in a closed loop between the heat pump's evaporator and the power plant's condenser. The water in the distribution pipeline circulates in another closed loop between the heat pump's condenser and the consumer heat exchanger units. The city of Philadelphia was used as the reference city for population density and climatic conditions. The cost of system was calculated under various circumstances. The parameters varied were the distance between the power plant and the heat pump stations, the temperature drop of the main line water in the heat pump's evaporator, the approach temperature of the heat exchanger in the district station, the annual heat load, and the monthly variations of the heat demand. The cost of the system was computed to be between 16 to 31 mills/kwhr depending on the operating condition. DOE

**N83-13617#** Battelle Columbus Labs., Ohio.
**TOTAL ENERGY FOOD PLANT 21 MILLION GALLON ETHANOL FACILITY Final Report**
Oct. 1981 571 p refs Prepared in cooperation with Chemapec, Inc., Woodbury, Ind. and Clark Dietz Engineers, Inc., Richmond, Ind. Prepared for Agri-Answer, Inc., Union City, Ind.
(Contract DE-FG07-80RA-50329)
(DE82-019258; DOE/RA-50329/1) Avail: NTIS HC A24/MF A01

The Phase I Engineering study includes the following: process description, waste water treatment plant, material summary, energy chart, capital cost estimate, equipment list, personnel requirements, drawings list, specifications list, and project schedule. The economic and financial feasibility of the technical process, and environmental, health, safety, and socio-economic assessments for the project are reported. The costs for extending the following utilities to the property line of the selected site are presented: potable water, sewer system, electricity, roads for truck traffic, and rail service. DOE

**N83-13619#** Cambridge Systematics, Inc., Berkeley, Calif.
**RESIDENTIAL END-USE ENERGY PLANNING SYSTEM (REEPS) Final Report**
A. GOETT and D. MCFADDEN Jul. 1982 167 p refs Sponsored by Electric Power Research Inst.
(Contract EPRI PROJ. 1211-2)
(DE82-906444; EPRI-EA-2512) Avail: NTIS HC A08/MF A01

The Residential End-Use Energy Planning System (REEPS) is described. REEPS is a forecasting model of residential energy patterns that is capable of evaluating the impacts of a broad range of energy conservation measures. REEPS forecasts appliance installations, operating efficiencies, and utilization patterns for space heating, water heating, air conditioning, and cooking. Each of these decisions is sensitive to energy prices, mandatory policies, and household/dwelling and geographical characteristics. The parameters of these choice models have been estimated statistically from national household survey data. The structure of the choice models and the results of the statistical analysis are reported in detail. REEPS forecasts energy choices for a large number of market segments representing households with different socioeconomic, dwelling, and geographical characteristics. These segments reflect the joint distribution of characteristics in the population. Aggregate forecasts are generated by summing up the decisions for all population segments. This technique provides a consistent method of obtaining aggregate forecasts from disaggregate, nonlinear choice models. Moreover, it permits evaluation of the distributional impacts of prospective conservation policies. The results of simulation of REEPS are described. DOE

**N83-13620#** Geothermal Development Associates, Reno, Nev.
**PRELIMINARY PLAN FOR THE DEVELOPMENT OF GEOTHERMAL ENERGY IN THE TOWN OF HAWTHORNE, NEVADA**
4 Nov. 1981 107 p refs
(DE82-904440; NP-2904440) Avail: NTIS HC A06/MF A01

Site characteristics pertinent to the geothermal development are described, including: physiography, demography, economy, and goals and objectives of the citizens as they relate to geothermal development. The geothermal reservoir is characterized on the basis of available information. The probable drilling depth to the reservoir, anticipated water production rates, water quality, and resource temperature are indicated. Uses of the energy that seem appropriate to the situation both now and in the near future at Hawthorne are described. The essential institutional requirements for geothermal energy development are discussed, including the financial, environmental, and legal and regulatory aspects. The various steps that are necessary to accomplish the construction of the geothermal district heating system are described. DOE

**N83-13621#** Geothermal Development Associates, Reno, Nev.
**PRELIMINARY PLAN FOR THE DEVELOPMENT OF GEOTHERMAL ENERGY IN THE TOWN OF GABBS, NEVADA**
Nov. 1981 104 p refs
(DE82-904441; NP-2904441) Avail: NTIS HC A06/MF A01

Characteristics of the site significant to the prospect for geothermal development are described, including: physiography, demography, economy, and the goals and objectives of the citizens as they relate to geothermal development. The geothermal resource evaluation is described, including the depth to reservoir, production rates of existing water wells, water quality, and the resource temperature. Uses of the energy that seem apropriate to the situation both now and in the foreseeable future at Gabbs are described. The essential institutional requirements for geothermal energy development are discussed, including the financial, environmental, legal, and regulatory requirements. The main resource, engineering and institutional considerations involved in a geothermal district heating system for Gabbs are summarized. DOE

**N83-13628#** Stockholm Univ. (Sweden). Inst. of Physics.
**SOME COMMENTS ON THE WORLD ENERGY CONFERENCE (WEC) ENERGY DEMAND MODEL**
L. BRANDELL (Royal Inst. of Tech., Stockholm) Apr. 1982 15 p refs
(USIP-82-04) Avail: NTIS HC A02/MF A01

The WEC model, relating the energy demand for a region in a year to gross national product (GNP), aggregated energy prices and elasticity constants, is generalized. The changes that result from the assumption that the elasticity factors are not constant are examined. The resulting differential equation contains the variables energy demand per capita and GNP per capita for the region considered. The effect of time lag in energy demand and the influence of the population growth rate are also included in the model. No projections of the future energy demand were made, but model sensitiveness to the modifications were studied. Time lag effects and population growth effects can raise the projected energy demand for a region by 10% or more. Author (ESA)

**N83-13630#** National Materials Advisory Board, Washington, D. C.
**AN ASSESSMENT OF THE INDUSTRIAL ENERGY CONSERVATION PROGRAM, VOLUME 2 Final report, Nov. 1980 - Apr. 1982**
May 1982 191 p refs
(Contract DE-AC01-80CS-40298)
(PB82-225780; NMAB-395-2) Avail: NTIS HC A09/MF A01
CSCL 10A

Industrial operations in the United States consume some 37 percent of the country's total energy, and it was estimated that this percentage will increase to 50 percent by 1990 unless appropriate conservation measures are applied. However, such measures are difficult to implement in spite of the potential offered by various technologies. Accordingly, a federal program was started in 1975 designed to mitigate the economic, technological, and institutional uncertainties via forms of government-industry partnership arrangements. The National Materials Advisory Board was requested in June 1980 to form a study committee to assess the effectiveness of the Industrial Energy Conservation Program which is administered by the Department of Energy. GRA

**N83-13644*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**AN ASSESSMENT OF GAS-SIDE FOULING IN CEMENT PLANTS**
W. J. MARNER Sep. 1982 109 p refs Sponsored in part by DOE
(NASA-CR-169513; JPL-PUB-82-83; NAS 1.26:169513;
DOE/ID-12138/2) Avail: NTIS HC A06/MF A01 CSCL 13B

The cement industry is the most energy-intensive industry in the United States in terms of energy cost as a percentage of the total product cost. An assessment of gas-side fouling in cement plants with special emphasis on heat recovery applications is provided. In the present context, fouling is defined as the buildup of scale on a heat-transfer surface which retards the transfer of heat and includes the related problems of erosion and corrosion. Exhaust gases in the cement industry which are suitable for heat recovery range in temperature from about 100 to 1300 K, are generally dusty, may be highly abrasive, and are often heavily laden with alkalies, sulfates, and chlorides. Particulates in the exhaust streams range in size from molecular to about 100 micrometers in diameter and come from both the raw feed as well as the ash in the coal which is the primary fuel used in the cement industry. The major types of heat-transfer equipment used in the cement industry include preheaters, gas-to-air heat exchangers, waste heat boilers, and clinker coolers. At the present time, the trend in this country is toward suspension preheater systems, in which the raw feed is heated by direct contact with the hot kiln exit gases, and away from waste heat boilers as the principal method of heat recovery. The most important gas-side fouling mechanisms in the cement industry are those due to particulate, chemical reaction, and corrosion fouling. Author

**N83-13647#** Brookhaven National Lab., Upton, N. Y. Biomedical and Environmental Assessment Div.
**A REFERENCE-MATERIAL SYSTEM FOR ESTIMATING HEALTH AND ENVIRONMENTAL RISKS OF SELECTED MATERIAL CYCLES AND ENERGY SYSTEMS**
M. A. CROWTHER and P. D. MOSKOWITZ Jul. 1981 120 p refs
(Contract DE-AC02-76CH-00016)
(DE82-019309; BNL-51563) Avail: NTIS HC A06/MF A01

Samples analyses and detailed documentation are presented for a Reference Material System (RMS) to estimate health and environmental risks of different material cycles and energy systems. Data inputs described include: end-use material demands, efficiency coefficients, environmental emission coefficients, fuel demand coefficients, labor productivity estimates, and occupational health and safety coefficients. Application of the model permits analysts to estimate fuel use (e.g., Btu), occupational risk (e.g., fatalities), and environmental emissions (e.g., sulfur oxide) for specific material trajectories or complete energy systems. Model uncertainty is quantitatively defined by presenting a range of estimates for each data input. Systematic uncertainty not quantified relates to the boundaries chosen for analysis and reference system specification. Although the RMS can be used to analyze material system impacts for many different energy technologies, it was specifically used to examine the health and environmental risks of producing four types of photovoltaic deivces. DOE

**N83-13649#** Marine Biological Lab., Woods Hole, Mass. Ecosystems Center.
**EFFECTS OF OIL ON TUNDRA PONDS AND STREAMS Final Report, 1 Oct. 1978 - 30 Sep. 1980**
J. E. HOBBIE May 1982 13 p refs
(Contract DE-AC02-76EV-02989)
(DE82-018899; DOE/EV-02989/2) Avail: NTIS HC A02/MF A01

The effects of nutrient enrichment on an arctic tundra stream were studied in 1979 and 1980. The site was the Kuparuk River of the North Slope of Alaska. Concentrations of phosphorus and nitrogen in the river were extremely low, and phosphorus was indicated as the most important limiting nutrient. An artificial stream was set up to observe the effects of added nutrients on periphyton biomass and photosynthesis. The phosphorus and phosphorus plus nitrogen enrichments showed significant increase in algal growth and production over the controls. Nitrogen alone gave no stimulus. The effects of petroleum hydrocarbons on the decomposition of plant litter was observed in an experimental setup simulating conditions in Toolik Lake, Alaska. Overall microbial activity and heterotrophic activity ((14)C acetate uptake) indicated no significant short term effect after oil addition. In longer experiments, the decomposition rate of lignin and cellulose components of Carex was observed by following (14)C labelled compounds. DOE

**N83-13651#** Saarberg-Fernwaerme G.m.b.H., Saarbruecken (West Germany).
**SFW-FUNK PROCESS FOR GASIFICATION OF SOLID URBAN AND INDUSTRIAL WASTE Final Report, Jul. 1980**
H. HUMMELSIEP and F. HEINRICH Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 230 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-117; ISSN-0340-7608) Avail: NTIS HC A11/MF A01

The development and testing of an urban and industrial waste gasification plant are described. Domestic waste of different compostion, grain size and closeness of grain and rubber and wood were gasified at varying operating conditions (composition, quantity and constitution of the oxidant) with good results.
Author (ESA)

**N83-13652#** Saarberg-Fernwaerme G.m.b.H., Saarbruecken (West Germany)
**MEASURING PROGRAM FOR THE R AND D PROJECT ON GASIFICATION OF DOMESTIC AND INDUSTRIAL WASTES Final Report, Jun. 1981**
H. HUMMELSIEP and E. LOEW Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 86 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-118; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18

Domestic and industrial waste incoming and outgoing material flows were analyzed. Waste as input material, screened fine fraction, gas produced, crude gas condensate (part tar - part water), ash produced, circulating water cooling, water ashbowl, fine fraction eluate, ash eluate, and waste water were examined. Quantities, compositions, energy content and pollutant quota are determined. Energy and mass relationships are derived. Author (ESA)

**N83-13657#** Rockwell International Corp., Newbury Park, Calif.
**QUALITY ASSURANCE IN SUPPORT OF ENERGY RELATED MONITORING ACTIVITIES Annual Report**
M. LEV-ON and M. CHER Apr. 1982 56 p refs
(Contract EPA-68-02-2412)
(PB82-234238; EPA-600/4-82-036; AR-3) Avail. NTIS HC A04/MF A01 CSCL 13B

The activities during the third year of the program entitled, Quality Assurance in Support of Energy Related Activities are discussed. Discussed are the regularly scheduled quality control reference sample audits conducted for the analysis of sulfate, nitrate, sulfur dioxide, nitrogen dioxide and carbon monoxide, and for weight measurement and high-volume flow rate. Performance results for the third year of the program remained essentially constant for sulfate, nitrate, sulfur dioxide and carbon monoxide. The results for carbon monoxide are noteworthy for their consistently high quality. Results for nitrogen dioxide show some improvement. GRA

**N83-13658#** Systems Applications, Inc., San Rafael, Calif.
**EVALUATION OF SHORT-TERM NO2 PLUME MODELS FOR POINT SOURCES. VOLUME 1. TECHNICAL DISCUSSION Final Report, Aug. 1977 - Jul. 1979**
M. A. YOCKE, D. A. STEWART, J. JOHNSON, and R. J. FROST Dec. 1981 194 p refs
(Contract EPA-68-02-2775)
(PB82-234329; EPA-600/4-81-079) Avail: NTIS HC A09/MF A01 CSCL 13B

Models for predicting short erm NO2 concentrations are discussed, and several (RPM-II, TCM, OLM, and CNOM) are selected for evaluation. The MISTT data, collected in 1976, were to be used to evaluate the models, but careful scrutiny of the data base revealed certain deficiencies relative to the data needs of the models. These deficiencies preclude a strict evaluation of the performance of the models, but simple fitting techniques were used to compensate for input data deficiencies. The models are shown to perform reasonably well using simple statistical measures of performance. The performance of the models is also evaluated using a 'restricted' data base (i.e., one that could be derived from NSW, local, or state agency data sources only), and model performance is shown to be poorer with the unrestricted data base. Author (GRA)

**N83-13659#** Southern Research Inst., Birmingham, Ala.
**SAMPLING FOR HIGH-MOLECULAR-WEIGHT ORGANIC COMPOUNDS IN POWER PLANT STACK GASES Final Report**
W. R. DICKSON, H. C. MILLER, and W. J. BARRETT May 1982 50 p
(Contract EPA-68-02-2272)
(PB82-234618; SORI-EAS-80-387; EPA-600/7-82-039) Avail: NTIS HC A03/MF A01 CSCL 13B

The results of laboratory and field investigations of experimental sampling systems intended to collect high molecular-weight organic compounds from flue gases in coal-fired power plants are presented. The most promising sampling device was a solid sorbent cartridge inserted directly into the flue gas stream and cooled to a temperature just above the dew point by a forced flow of external ambient air. Although certain sorbent materials were shown to be partially effective for the collection of vapors of polynuclear aromatic hydrocarbons at temperatures of 50 to 60 C, no completely satisfactory sorbert was found. Ambersorb XE340, a nonpolar carbonaceous sorbent, was the most satisfactory of several organic and inorganic sorbent materials tried, but its usefulness was limited by the presence of contaminants that could not be removed.
Author (GRA)

**N83-13664#** Radian Corp., Austin, Tex.
**IMPACT OF NOX SELECTIVE CATALYTIC REDUCTION PROCESSES ON FLUE GAS CLEANING SYSTEMS Final Report, Oct. 1980 - Oct. 1981**
G. D. JONES, R. L. GLOVER, G. P. BEHRENS, and T. E. SHIRLEY Apr. 1982 103 p refs
(Contract EPA-68-02-3171)
(PB82-240086; RAD-81-202-187-70-15; EPA-600/7-82-025B)
Avail: NTIS HC A06/MF A01 CSCL 13B

The report gives results of a study of the impact of the ammonia leaving a nitrogen oxide (NOx) selective catalytic reduction (SCR) process on downstream flue gas cleaning processes. (NOx emissions from electric utility boilers may be reduced 80-90% by the application of pollution control technology based on the SCR of NOx with ammonia; however, some unreacted ammonia may be emitted from the control system.) These processes include electrostatic precipitators (ESPs), baghouses, and flue gas desulfurization (FGD) systems. In normal operation, most ammonia leaving the SCR system will be removed, either as particulate salts by the particulate removal system or as free ammonia by the FGD system. Very little ammonia should be emitted at the stack. Author (GRA)

**N83-13665#** Acurex Corp., Mountain View, Calif.
**ENVIRONMENTAL ASSESSMENT OF STATIONARY SOURCE NOX CONTROL TECHNOLOGIES Final Report, Jun. 1976 - Sep. 1979**
L. R. WATERLAND, K. J. LIM, E. B. HIGGINBOTHAM, R. M. EVANS, and H. B. MASON May 1982 339 p refs
(Contract EPA-68-02-2160)
(PB82-249350, EPA-600/7-82-034; REPT-80-57/EE) Avail: NTIS HC A15/MF A01 CSCL 13B

Results of a 3-year evaluation of combustion modification controls for emissions of NOx and other pollutants from stationary combustion sources are given. Results include field tests of gaseous, liquid, and solid effluents from seven stationary sources; estimates of environmental effects of using combustion modification control; evaluation of NOx control reduction effectiveness, capital and operating costs, and operational impact for several levels of control; projection of control technology needs to the year 2000 for several scenarios of energy growth and environmental regulations; and inventories of nationwide stationary source emissions for major pollutants and emission projections to the

year 2000. Three utility boilers, two industrial boilers, a gas turbine, and a low-emission residential heating system were tested. GRA

**N83-13666#** *Ebon Research Systems, Washington, D.C.*
**EMERGING TECHNOLOGIES FOR THE CONTROL OF HAZARDOUS WASTES Final Report**
B. H. EDWARDS, J. N. PAULLIN, and K. COGHLAN-JORDAN Mar. 1982 158 p refs
(Contract EPA-68-03-2787)
(PB82-236993; EPA-600/2-82-011) Avail: NTIS HC A08/MF A01 CSCL 13B

Technologies for the disposal of hazardous wastes were investigated. The need for a data base for emerging hazardous waste technologies was evaluated. Information on the emerging technologies was acquired by computerized search, library searching, and personal contacts. Technologies discussed include: molten salt combustion, fluidized bed incineration, high energy electron treatment of trace organic compounds in aqueous solution, the catalyzed wet oxidation of toxic chemicals, dehalogenation of compounds by treatment with ultraviolet (UV) light and hydrogen, UV/chlorinolysis of organics in aqueous solution, the catalytic *hydrogenation-dechlorination of polychlorinated biphenyls (PCB's),* and ultraviolet/ozone destruction. Theory, specific wastes treated, and economics are discussed. GRA

**N83-13669#** Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.
**PROCEEDINGS OF THE 3RD CONFERENCE ON WASTE HEAT MANAGEMENT AND UTILIZATION**
May 1982 953 p refs Conf. held at Miami Beach, Fla., 11-13 May 1981 Sponsored by EPA
(PB82-227901; EPA-600/9-82-008) Avail: NTIS HC A99/MF A01 CSCL 13B

The conference addressed programs in waste heat management and utilization, utilization of waste heat from industrial processes, thermal discharges and related phenomena, cooling towers and their effects, greenhouse applications of waste heat, environmental effects of waste heat discharges to water bodies, and management and regulatory aspects of waste heat. GRA

**N83-13670#** Municipal Environmental Research Lab., Cincinnati, Ohio. Wastewater Research Div.
**TECHNOLOGY ASSESSMENT OF ANAEROBIC SYSTEMS FOR MUNICIPAL WASTEWATER TREATMENT: PART 1. ANAEROBIC FLUIDIZED BED. PART 2. ANFLOW Final Report, Aug. 1980 - Aug. 1981**
J. A. HEIDMAN Feb. 1982 59 p refs
(PB82-229170; EPA-600/2-82-004) Avail: NTIS HC A04/MF A01 CSCL 13B

Two developing technologies for the treatment of municipal wastewaters are described. These technologies are anaerobic fluidized bed systems and an anaerobic fixed-film bioreactor (ANFLOW). The topics discussed include: available laboratory data *on system performance, fluidized bed expansion and* voidage-velocity relationships; the influence of bacterial growth on changes in fluidization characteristics; power requirements for fluidization; potential cost and energy savings compared to activated sludge secondary treatment plants; and estimates of anaerobic fluidized bed treatment costs. GRA

**N83-13972#** State Planning Council on Radioactive Waste Management, Washington, D.C.
**RECOMMENDATION ON NATIONAL RADIOACTIVE WASTE MANAGEMENT POLICIES Report to the President**
1981 67 p
(DE81-029916; DOE/TIC-1029916) Avail: NTIS HC A04/MF A01

Sound technical solutions to the problems of waste disposal cannot be carried out without public acceptance. The key to gaining the public's confidence is a process of decision making which is open and accessible to elected officials from all levels of government. Such a process can be put in place through a renewal of the traditional principles of the federal system of government State, local, and tribal officials must become working partners with the federal government in making the crucial decisions about how radioactive wastes will be handled, transported, and ultimately disposed. *A workable and effective partnership must include, first* the full sharing of information and plans regarding waste disposal activities among all levels of government and, second, the opportunity for state, local, and tribal governments to participate effectively in waste management decisions which affect their jurisdictions. DOE

**N83-13973#** Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
**PARAMETRIC STUDY OF GEOHYDROLOGIC PERFORMANCE CHARACTERISTICS FOR NUCLEAR-WASTE REPOSITORIES**
C. E BAILEY and I. W. MARINE 1981 19 p refs Presented at the Geol. Soc. of Am. Meeting, Cincinnati, 2-5 Nov. 1981
(Contract DE-AC09-76SR-00001)
(DE82-003145; DP-MS-81-36; CONF-811142-1) Avail: NTIS HC A02/MF A01

Geohydrologic information in graphical form covering a wide range of parameters to aid in determining site specifications based on functional criteria are presented. Graphs of the major performance characteristics that influence the transport of radionuclides from a repository to the biosphere by groundwater are developed. The major characteristics addressed are radioactive decay, leach rate, hydraulic conductivity, porosity, groundwater gradient, hydrodynamic dispersion, ion exchange, and distance to the biosphere. GRA

**N83-13976#** California Univ., Livermore. Lawrence Livermore Lab.
**SYNROC PROCESSING OPTIONS**
R. B. ROZSA and C. L. HOENIG 1 Sep. 1981 16 p refs
(Contract W-7405-ENG-48)
(DE82-004230; UCRL-53187) Avail: NTIS HC A02/MF A01

Synroc is a titanate-based ceramic material currently being developed for immobilizing high-level nuclear reactor wastes in solid form. Synroc D is a unique variation of Synroc. It can contain the high-level defense wastes, particularly those in storage at the Savannah River Plant. The early development of the initial Synroc process is reviewed, modification and other options that simplify it overall are discussed, and the future direction of research and development in the processing area is recommended. A reference Synroc process is described and contrasted with the Savannah River Laboratory glass-based reference case Preliminary engineering layouts show Synroc to be a more complex processing operation and, thus, more expensive than the glass-based process. Possible simplifications, can significantly reduce the cost difference. Research and development continues in the areas of slurry processing, fluidized bed calcination, and mineralization using sintering, hot uniaxial pressing, or hot isostatic pressing. DOE

**N83-13977#** Centro Informazioni Studi Esperienze, Milan (Italy).
**THE EXPERIENCE COLLECTED IN THE MANAGEMENT OF THE CENTRO INFORMAZIONI STUDI ESPERIENZE (CISE) RADIOACTIVE WASTE FROM 1960 TO 1980 [ESPERIENZE ACQUISITE NELLA GESTIONE DEI RIFIUTI RADIOATTIVI AL CISE DAL 1960 AL 1980]**
C. TRIULZI and N. CARIFI 1981 18 p refs In ITALIAN Presented at 22nd A.I.R.P. Congr., Gardone, Italy, 23-26 Jun. 1981
(CISE-1738) Avail: NTIS HC A02/MF A01

The radioactive waste produced in a research center, its processing and destination are described. The radioactive waste is mainly solid (26 cu m) or inorganic liquid (65 cu m), although some paste (3 cu m) and organic liquids (0.1 cu m) were also produced. The disposal in each material category is described, including a block diagram of the liquid radioactive waste treatment plant. A time table shows that at the end of the period the stock of radioactive waste was reduced to 10 cu m. Author (ESA)

**N83-14074#** Comptroller General of the United States, Washington, D.C.
**AIRCRAFT THRUST/POWER MANAGEMENT CAN SAVE DEFENSE FUEL, REDUCE ENGINE MAINTENANCE COSTS, AND IMPROVE READINESS**
29 Jul. 1982 51 p refs
(GAO/PLRD-82-74) Avail: NTIS HC A04/MF A01

It was found that the Department of Defense could achieve additional savings in aircraft fuel and reduce engine maintenance costs by making greater use of reduced power takeoffs and climbs by fighter aircraft. It is recommended that effective local initiatives be better identified, reviewed, and implemented whenever possible. R.J.F.

**N83-14116#** Logistics Management Inst., Washington, D. C.
**IMPROVING ENERGY EFFICIENCY OF MAJOR WEAPON SYSTEMS Final Report**
D. J. S. PETERSON and C. D. STEVENSON Jul. 1982 50 p refs
(Contract MDA903-81-C-0166)
(AD-A119563; LMI-ML111) Avail: NTIS HC A03/MF A01 CSCL 21D

The increasing cost of fuel consumed by major weapon systems is a continuing concern for the Department of Defense (DoD). Because fuel costs are growing more rapidly than other Operating and Support (O&S) costs, they are consuming a growing fraction of the O&S budget. One solution to the problem is to place greater emphasis on acquiring energy efficient weapon systems. The efficient use of energy in major systems will help assure that the DoD will get the highest level of performance for every fuel dollar spent. The major system acquisition process serves as the framework for incorporating energy efficiency into system design and development. Not all systems are energy intensive and not all would benefit from increased attention to energy. This report defines a method for determining which systems are energy intensive using an energy consumption threshold specific to the warfare area of the system under consideration. We recommend that systems designated energy intensive be subjected to a more detailed analysis of energy consumption and cost, including the sensitivity of system life cycle costs to changes in energy costs. The report provides a case study to demonstrate how the recommended analytical methods can be performed within the life cycle cost analysis required for major weapon systems. Author (GRA)

**N83-14302#** Oak Ridge National Lab., Tenn
**HEALTH EFFECTS RESEARCH IN DIRECT COAL LIQUEFACTION. STUDIES OF H-COAL DISTILLATES. PHASE 1: PDU SAMPLES; THE EFFECTS OF HYDROTREATMENT**
J. L. EPLER, R J. M. FRY, and F. W. LARIMER Nov. 1981 66 p refs
(Contract W-7405-ENG-26)
(DE82-003702; ORNL/TM-8071) Avail: NTIS HC A04/MF A01

A multi-divisional effort aimed at the integrated assessment of the health and environmental effects of various coal conversion and shale oil technologies is discussed. The feasibility of using health effects bioassays to predict the potential biohazard of various H-Coal derived test materials is examined in a coupled chemical and biological approach. The primary focus is the use of preliminary chemical characterizations and preparation for bioassay, followed by testing in short-term assays in order to rapidly ascertain the potential biohazard. Mammalian toxicological assays parallel the testing. Raw and hydrotreated product liquids from process development units of H-Coal and the pilot plan solvent refined coal process were examined for acute toxicity monitored as population growth impairment of Tetrahymena exposed to aqueous extracts and for mutagenic activity monitored as revertants of Salmonella exposed to metabolically activated chemical class fractions. Medium to high severity hydrotreatment appears to be an effective means of reducing biological activity. DOE

**N83-14312#** Escher Technology Associates, St. Johns, Mich Div of Paper Machines.
**AIR CIRCUIT WITH HEAT PUMP**
H. HOLIK, H. J. BAUDER, H. BRUGGER, A. REINHART, and K. H. SPOTT Dec. 1980 39 p refs Transl. into ENGLISH of "Luftkreislauf mit Warmepump" rept. Bundesministerium fuer Forschung und Technologie, Bonn Original language document was announced as N82-12404
(PB82-221219; BMFT-FB-T-80-188) Avail: NTIS HC A03/MF A01 CSCL 13A

In the production of paper, a water quantity of approximately 1.5 times the weight of the finished paper is vaporized. The energy needed for this is lost in the ensuing water vapor during the drying process. It is demonstrated that energy consumption in drying paper can be reduced by using a heat pump to heat the blown air instead of the conventional steam heating. The exhaust from the drying section serves to supply heat for the pump. GRA

**N83-14575*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**AUTOMATIC INTERPRETATION OF MSS-LANDSAT DATA APPLIED TO COAL REFUSE SITE STUDIES IN SOUTHERN SANTA CATARINA STATE, BRAZIL**
N. D. J. PARADA, Principal Investigator, H. J. H. KUX, and D. D. M. VALERIANO May 1982 12 p refs Presented at the 16th Intern. Symp. on Remote Sensing of Environ., Buenos Aires, 2-9 Jun. 1982 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E83-10066; NASA-CR-169577; NAS 1.26:169577; INPE-2410-PRE/119) Avail: NTIS HC A02/MF A01 CSCL 05B

The coal mining district in southeastern Santa Catarina State is considered one of the most polluted areas of Brazil. The author has identified significant preliminary results on the application of MSS-LANDSAT digital data to monitor the coal refuse areas and its environmental consequences in this region. Author

**N83-14664#** General Accounting Office, Washington, D. C.
**DEVELOPING ALASKA'S ENERGY RESOURCES: ACTIONS NEEDED TO STIMULATE RESEARCH AND IMPROVE WETLANDS PERMIT PROCESSING**
17 Jun. 1982 93 p refs
(GAO/EMD-82-44; B-204637) Avail: NTIS HC A05/MF A01, SOD HC $3.25

A need for additional Arctic research is identified and changes in the Corps of Engineers' wetlands permitting process are called for. This review was conducted to determine the effectiveness of Federal agencies' efforts to minimize the negative environmental impacts of oil and gas-related activities on Federal lands in Alaska. L.F.M.

**N83-14734#** European Space Research and Technology Center, Noordwijk (Netherlands).
**OUTLOOK FOR SPACE ENERGY SYSTEMS AT THE END OF THE THREE-YEAR ASSESSMENT**
D. KASSING *In* ESA Photovoltaic Generators in Space p 277-284 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

Satellite power transmission to Earth was studied. The technical feasibility and economic practicality of photovoltaic conversion subsystems are reviewed and consequences for Europe for future R and D in related areas are discussed. A satellite power system based on multiband gap GaAs cells is commercially feasible, although state of the art silicon cells could be used in early experiments The concept is more attractive for Europe than for the United States, whose domestic energy production capacity is probably adequate for the next three or four decades. Author (ESA)

**N83-14739#** Newcomb and Boyd, Atlanta, Ga.
**CONTROLLING ENERGY CONSUMPTION IN SINGLE BUILDINGS Final Report, period ending May 1982**
J. REES Jul 1982 111 p refs
(Contract N62583-81-MR-593)
(AD-A118898; NCEL-CR-82.028) Avail: NTIS HC A06/MF A01 CSCL 13A

This report contains guidelines for using microprocessor-based equipment to control energy in buildings. Energy conservation control strategies are discussed and simplified energy savings calculations explained. The results of a survey of currently available equipment suitable for use as energy controllers is included as well as selection guidance for which class of equipment will provide the needed features. GRA

**N83-14745#** Department of Energy, Washington, D. C. Wind Energy Technology Div.
**PROSPECTS FOR FOREIGN APPLICATIONS OF WIND-ENERGY SYSTEMS, PRELIMINARY REPORT IN RESPONSE TO PUBLIC LAW 96-345**
4 Nov. 1981 18 p refs
(DE82-007930; DOE/NBM-1005) Avail: NTIS HC A02/MF A01

Potential foreign applications were identified. Specific systems which would most closely match the applications requirements from a list of representative U.S. wind energy systems. The energy situation of each of 155 countries and 29 territories was reviewed. Wind resources availability for each country was assessed from existing data sources. The export potential was determined by analyzing a country's applications requirements, cost of alternative energy, financial condition, interest in the development of renewable energy technologies, and level of indigenous competition DOE

**N83-14753#** Delaware State Solid Waste Authority, Dover.
**ENERGY RESOURCE RECOVERY FACILITY FOR KENT AND SUSSEX COUNTIES, DELAWARE**
Nov. 1981 180 p Prepared jointly with CSI Resource Systems, Inc.
(Contract DE-FG01-79CS-20234)
(DE82-002539; DOE/CS-20234-1) Avail: NTIS HC A09/MF A01

An outline of factors which should be considered in planning a solid waste facility is presented. The following topics are considered: (1) information on the technical findings; (2) existing waste disposal facilities, future systems, and waste characteristics; (3) markets for the waste resources are identified; (4) presents a rational means for site evaluation by assigning numerical values to four principal factors in decision making; (5) the refuse derived fuel system and the modular combustion system is described; (6) risks and implementation issues for the most promising systems are identified. GRA

**N83-14757#** Pacific Northwest Lab., Richland, Wash.
**ENVIRONMENTAL AND REGULATORY ASPECTS OF COMPRESSED-AIR ENERGY STORAGE**
M. A. BECKWITH and J. MATHUR 1981 10 p refs Presented at Intern. Energy Storage Conf., Seattle, 19 Oct. 1981
(Contract DE-AC06-76RL-01830)
(DE82-003868; PNL-SA-9500; CONF-811066-4) Avail: NTIS HC A02/MF A01

The effects of fuel regulations, environmental protection laws, the National Environmental Policy Act, underground injection regulations, and state regulations on the development of compressed air storage systems and power plants are discussed. It is concluded that environmental regulatory concerns of conventional energy technologies are often different from those associated with new technologies such as compressed air energy storage (CAES). Confusion and uncertainty often results when the current environmental regulatory system is applied to new technologies. Evolution of the regulatory system must accompany and rapidly accommodate technological development if the benefits of such development are to be fully realized in a timely manner. Those responsible for technological development in the energy field must be aware of these disparities and conduct their efforts accordingly. DOE

**N83-14765#** Centro Informazioni Studi Esperienze, Milan (Italy). Documentation Service.
**REGIONAL ENERGY PLANNING: SOME SUGGESTIONS TO PUBLIC ADMINISTRATION [PIANIFICAZIONE ENERGETICA TERRITORIALE: ALCUNI SUGGERIMENTI AGLI AMMINISTRATORI PUBBLICI]**
R. SOZZI 1982 21 p In ITALIAN Presented at Sem. sul Piano per l'Uso Razionale dell'Energia in Emilia-Romagna, Bologna, 21 May 1982
(CISE-1795) Avail: NTIS HC A02/MF A01

A methodology is proposed to estimate the relevant data and to improve the energy efficiency in regional energy planning. The quantification of the regional energy system is subdivided in three independent parameters which are separetely estimated: energy demand, energy consumption, and transformation capacity. Definitions and estimating procedures are given. The optimization of the regional planning includes the application, wherever possible, of the technologies which centralize the space-heating energy production or combine the production of electric energy with space-heating energy distribution. Author (ESA)

**N83-14767#** General Accounting Office, Washington, D. C.
**CLEANING UP THE ENVIRONEMNT: PROGRESS ACHIEVED BUT MAJOR UNRESOLVED ISSUES REMAIN**
21 Jul. 1982 69 p refs 2 Vol.
(GAO/CED-82-72, B-207657) Avail. NTIS HC A04/MF A01

Air quality, water quality, solid waste disposal, ocean dumping, and noise abatement are discussed. Acid precipitation, nonpoint sources of water pollution, ground water contamination, ocean waste disposal, compliance, and pollution control decisions comprise a list of unresolved issues. N.W

**N83-14770#** General Accounting Office, Washington, D. C Energy and Minerals Div.
**NUCLEAR AND COAL WASTE DISPOSAL HAMPERED BY LEGAL, REGULATORY AND TECHNICAL UNCERTAINTIES**
4 May 1982 4 p refs
(EMD-82-63; B-204622) Avail: NTIS HC A02/MF A01; also available from SOD HC $3.25

Numerous legal, regulatory, and technical problems and uncertainties are hampering disposal of nuclear and coal fuel cycle wastes The following issues are investigated· problems associated with waste collection and disposal, present technical capability of waste collection and disposal, present capability of the transportation system to transport wastes, disposal, regulations and uncertainties affecting waste disposal, and current status of programs aimed at resolving these issues. L.F.M.

**N83-14772#** Research Tnangle Inst., Research Triangle Park, N.C.
**BOILER EFFICIENCY AND EMISSIONS TESTING USING REFUSE-DERIVED FUEL (RDF) AND COAL Final Report, 21-26 Feb. 1982**
Brooks AFB, Tex. AFOEHL Aug. 1982 54 p Prepared in cooperation with Entropy Environmentalists, Inc.
(Contract F33615-80-D-4000; AF PROJ. 1955)
(AD-A119291; RTI-43U-1955-14; OEHL-TR-82-017EA206HEF)
Avail: NTIS HC A04/MF A01 CSCL 13A

This report is an evaluation of (1) boiler performance, i.e., boiler efficiency and combustion properties; and (2) environmental emissions, i.e , electrostatic precipitator performance, particulate emissions (size and resistivity), gaseous emissions (SOx, NOx, CO and HC) and trace organics; while burning the following three fuel combinations at maximum boiler capacity; (1) 100% coal, (2) 40/60 refuse-derived fuel (RDF) to coal; and (3) 100% RDF.
Author (GRA)

**N83-14774#** Monsanto Research Corp., Miamisburg, Ohio.
**TRITIUM WASTE CONTROL: OCTOBER 1980 - MARCH 1981**
P. H. LAMBERGER and M. L. ROGERS 19 Oct. 1981 18 p refs
(Contract DE-AC04-76DP-00053)
(DE82-002088; MLM-2844) Avail: NTIS HC A02/MF A01

The Combined Electrolysis Catalytic Exchange (CECE) pilot system was operated for 88 days and processed over 500 liters of tritiated water. Two complete electrolysis systems, each using a General Electric Company solid polymer electrolyte (SPE) cell, have been built. One of these is being used for the 10 Ci/ml tritiated water test and the other as a control with nontritiated water. The first SPE failed after seven weeks of exposure to the 10 Ci/ml water. A new SPE was installed and has been operated for eight weeks without failure at 10 Ci/ml. Analyses for 10 types of impurities were made on each of 15 Effluent Recovery System (ERS) liquid waste samples. A pilot-scale system for removal of these impurities has been designed and is being built. Gas generation rates caused by radiolysis of tritium waste materials were determined for polymer and nonpolymer impregenated tritiated concrete. The construction of the new addition to the liquid waste handling facility was completed. DOE

**N83-14776#** Pennsylvania State Univ., University Park. Dept. of Chemistry.
**DEVELOPMENT OF INSTRUMENTAL METHODS OF ANALYSIS OF SULFUR COMPOUNDS IN COAL-PROCESS STREAMS Quarterly Progress Report, Jul. - Sep. 1981**
J. JORDAN, J. STAHL, and J. E. YAKUPKOVIC Oct. 1981 35 p refs
(Contract DE-AC22-77ET-10482)
(DE82-003291; DOE/ET-10482/T3) Avail: NTIS HC A03/MF A01

The polarography of mixtures containing HS(-1), S4(-2) and S5(-2) was investigated at the dropping mercury electrode in aqueous supporting electrolytes of pH 8.7 and 9.4. Cathodic waves were obtained which exhibited a large polarographic maximum, followed by a well-defined limiting current region. The limiting current was proportional to the sum of S4(-2) + S5(-2) anomaly that interfered at pH 12, viz., a dip in the limiting current spanning half a volt, was minimized at pH less than 9. Thermochemical data collection, storage, and analysis were fully computerized. Thermometric enthalpy titration curves (TET) were computer corrected to yield an enthalpogram in terms of net heats of chemical reactions plotted versus time. Non-idealities such as heat capacity changes and extraneous heat losses were automatically compensated A thermochemical method for determining polysulfides, utilizing HMB as a titrant, was validated in an aqueous coal liquefaction process stream. DOE

**N83-14778#** Oak Ridge National Lab., Tenn. Environmental Sciences Div.
**EFFECTS OF ACID PRECIPITATION ON ELEMENTAL TRANSPORT FROM TERRESTRIAL TO AQUATIC ECOSYSTEMS**
D. W. JOHNSON 1981 9 p refs Presented at the Intern. Conf. on Energy Use Management, 3, West Berlin, 26 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-002739; CONF-811006-7) Avail: NTIS HC A02/MF A01

Significant progress was made in terrestrial aquatic transport methodology. Several techniques and conceptual frameworks are available for assessment of acid rain effects on these transport processes. It is possible to assess the relative effects of acid rain vs natural, internal acid production on elemental transfer rates is assessed by anion model. Sensitivity must be defined for ecosystem and effects that are considered. Criteria are developed, but there is a major need for more information on natural acid production. GRA

**N83-14781#** Battelle Pacific Northwest Lab., Sequim, Wash. Marine Research Lab.
**COAL FLY ASH DISPOSAL IN THE OCEAN: AN ALTERNATIVE WORTH CONSIDERING**
E. A. CRECELIUS 1981 20 p refs Presented at the 3d Intern. Ocean Dumping Symp., Woods Hole, Mass , 12 Oct. 1981
(Contract DE-AC06-76RL-01830)
(DE82-003835; PNL-SA-9657; CONF-8110104-3) Avail: NTIS HCA02/MF A01

Chemical and biological experiments measured the solubility of 16 elements in coal fly ash and the short-term toxicity of coal fly ash to clams and phytoplakton. Of the elements studied, 10 to 60% of the As, Br, Cr, Sb, Se, Ni, Pb, and Sr dissolved within a 24-hour period. Elements which were less than 10% soluble in 24-hours included Cu, Zn, Na, La, Sc, Fe, Co and Eu. Littleneck clams (Protothaca staminea) were exposed to coal fly ash in flowing seawater for a 25-day period. The addition of soluble coal fly ash material had no effect on the carbon uptake rate of phytoplakton. These measurements were made in the productive Washington shelf water during August. The literature indicates coal fly ash has a relatively low toxicity to plants and animals Disposal methods could be designed so water quality criteria levels would not be exceeded except in the immediate vicinity of the dumpsite. DOE

**N83-14783#** Grosskraftwerk A.G , Mannheim (West Germany). Abteilungsleitung Forschung und Entwicklung.
**IMPROVEMENT OF ELECTROSTATIC PRECIPITATORS PERFORMANCE THROUGH CONDITIONING BY FLUE GAS Final Report, Apr. 1981**
E. JURY Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 63 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-123; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13,50

The influence of conditioning of flue gas by water on the performance of electrostatic precipitators was investigated in connection with power station precipitators, since the increasing use of coal of varying charactenstics may considerably aggravate operating conditions. After the air preheater, water is injected through spraying nozzles into an evaporation vessel to cool down the flue gas. The precipitator efficiency rises, e.g. with flue gas cooled down from 154 to 90 C, from 89 to 97.6 % The plant worked troublefree for 22 months. Conditioning by water can be applied in the case of cyclone boilers. The precipitator size can be reduced. The reduction of the temperature permits an adaptation to the coal characteristics. Author (ESA)

**N83-14968#** Council for Scientific and Industrial Research, Pretoria (South Africa). Dept. of Mineral and Energy Affairs.
**ENERGY POLICY FORMULATION IN SOUTH AFRICA. APL AS A TOOL TO IDENTIFY OPTIONS**
R. B. SILBERBERG *In its* 1st South African APL Symp. 15 p 1982 refs
Avail: NTIS HC A08/MF A01

The energy situation and the options that face the policymaker in South Africa are outlined. APL is used to develop models of the supply and demand sectors and project future energy scenarios, to provide a basis for policy formulation. The process as it is applied to coal exports, is described. E.A.K.

**N83-15113#** Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
**VITRIFICATION OF HIGH-LEVEL RADIOACTIVE WASTE IN A SMALL-SCALE JOULE-HEATED CERAMIC MELTER**
M. J. PLODINEC and G. B. WOOLSEY 1981 11 p refs Presented at the Ann. Meeting of the Mater. Res. Soc., Boston, 16 Nov. 1981
(Contract DE-AC09-76SR-00001)
(DE82-002227; DP-MS-81-54; CONF-811122-6) Avail: NTIS HC A02/MF A01

Direct feeding of actual liquid-waste slurries to the small melter is discussed. The liquid-feeding tests demonstrated that addition of premelted glass frit to the waste slurry reduces the amount of material volatilized. Results of these tests are in accord with results of large-scale tests with actual waste. DOE

**N83-15114#** International Atomic Energy Agency, Vienna (Austria).
**PACKAGING OF RADIOACTIVE WASTES FOR SEA DISPOSAL**
1981 43 p refs Presented at a Tech. Comm. Meeting on Containers and Packaging for Ocean Dumping, Vienna, 3-7 Dec. 1979
(IAEA-TECDOC-240; CONF-791266) Avail. NTIS (US Sales Only) HC A03/MF A01; DOE Depository Libraries

The Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter, known as the London Dumping Convention was adopted by an inter-governmental conference in London in 1972 and came into force in 1975. In 1977, the IAEA Board of Governors agreed that there is a continuing responsibility for the IAEA to contribute to the effectiveness of the London Dumping Conventions by providing guidance relevant to the various aspects of dumping radioactive wastes at sea. In the light of the above responsibilities, the IAEA organized a Technical Committee Meeting from 3 to 7 December 1979 to assess the current situation concerning the requirements and the practices of packaging radioactive wastes for dumping at sea with a view to providing further guidance on this subject. The results of this meeting are summarized. DOE

**N83-15115#** Commission of the European Communities, Brussels (Belgium). Directorate General for Research, Science and Education
**RISKS, REGULATION RESPONSIBILITIES AND COSTS IN NUCLEAR WASTE MANAGEMENT: A PRELIMINARY SURVEY IN THE EUROPEAN COMMUNITY**
S. ORLOWSKI 1980 41 p refs
(EUR-6893) Avail: NTIS (US Sales Only) HC A03/MF A01; DOE Depository Libraries

The use of nuclear energy produces radioactive waste which may present risks of pollution for man and his environment. Their protection must be ensured by technical or institutional controls. The report examines the second, i.e., the administrative, legal and financial measures, dealing with the management of radioactive waste in existence or under consideration within the Member States of the European Community. The following aspects are studied: laws and regulations, authorities concerned, costs and financing of radioactive waste management, civil liability, national policies, international aspects of radioactive waste management. DOE

**N83-15401#** Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
**STUDY OF THE FORMATION OF SUBMICRON PARTICULATES GENERATED BY COAL COMBUSTION Quarterly Progress Report, 1 Jul. - 1 Oct. 1981**
P. M. SHERMAN and D. R. GLASS Nov. 1981 20 p refs
(Contract DE-FG22-80PC-30305)
(DE82-003268, DOE/PC-30305/T4; QPR-4) Avail: NTIS HC A02/MF A01

The mineral matter in coal fouls boiler surfaces and produces particulates which can be detrimental to vegetation and hazardous when inhaled. The particulates emitted have been controlled to some extent by costly add-on equipment. Such equipment is more effective in removing the larger particles than the smaller particles The smaller ones are the ones however, which can be the most hazardous. They tend to be enriched in many of the most toxic elements and are the ones that tend to stay in the lungs and may adhere to boiler surfaces. If formation of these particles can be prevented, costly clean up could be eliminated. Our purpose is to investigate the mechanisms which result in submicron particles so that we may prescribe ways to prevent their formation. This quarter has been devoted to examining some of the gross trends in the particulate emissions as a function of heat transfer and combustion parameters. DOE

**N83-15659*#** Crane Packing Co., Morton Grove, Ill.
**ENERGY EFFICIENT FACE SEAL**
J. SEHNAL, J. SEDY, I ETSION, and A. ZOBENS 11 Feb. 1982 113 p refs
(Contract NAS3-22128)
(NASA-CR-165591; NAS 1.26.165591) Avail: NTIS HC A06/MF A01 CSCL 11A

Torque, face temperature, leakage, and wear of a flat face seal were compared with three coned face seals at pressures up to 2758 kPa and speeds up to 8000 rpm. Axial movement of the mating seal parts was recorded by a digital data acquisition system. The coning of the tungsten carbide primary ring ranged from .51 micro-m to 5.6 micro-m. The torque of the coned face seal balanced to 76.3% was an average 42% lower, the leakage eleven times higher, than that of the standard flat face seal The reduction of the balance of the coned face seal to 51 3% resulted by decreasing the torque by an additional 44% and increasing leakage 12 to 230 times, depending on the seal shaft speed No measurable wear was observed on the face of the coned seals. E A K.

**N83-15915#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**THE SERI WIND ENERGY PROGRAM**
I. E. VAS (Flow Industries, Inc.) *In its* Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 93-106 1981 refs
(Contract EG-77-C-01-4042)
Avail: NTIS HC A23/MF A01

The widespread implementation of wind energy is supported by conducting research and development studies. The activities fall into three general areas-planning, management and analysis; advanced and innovative concepts; and information development. In the first area, the work conducted relates to economic, application, legal, social and environmental studies which are generic and could be applied to a wide range of machine size and type. The second area of responsibility lies with the directing and managing of advanced and innovative concepts--those high risk concepts that offer the potential of improving upon the cost of energy of conventional systems and of increasing the wide spread implementation of wind systems into populated areas. The third area of responsibility relates to the development of informational documents which are designed for specific audiences. This activity generally supports the Solar Energy Information Data Bank in their efforts to provide general information in response to inquiries on wind energy. S.L.

**N83-15955#** Oak Ridge National Lab., Tenn.
**ALTERNATIVE MEANS OF COPING WITH NATIONAL ENERGY EMERGENCIES**
J. H. SORENSEN 1981 9 p refs Presented at the 3rd Intern. Conf. on Energy Use Management, West Berlin, F. R., Germany, 26 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-002812; CONF-811006-8) Avail: NTIS HC A02/MF A01

A comprehensive management framework is suggested for coping with largescale energy shortages. In doing so, events that may trigger a shortage are overviewed. A systems model of a shortage is discussed. Alternative management strategies are suggested and concepts of evaluating the strategies are briefly reviewed. The conclusion is made that national policies should emphasize a broad-based approach to coping with shortages with long term goals of preventing the events that cause emergencies. DOE

**N83-15960#** California Univ., Livermore. Lawrence Livermore Lab.
**IDEAS FOR IMPLEMENTING AIR-QUALITY STUDIES IN THE WESTERN ROCKY MOUNTAIN REGION**
M. H. DICKERSON Jul. 1982 16 p refs Presented at the 2nd Conf. on Oil Shale: The Environ. Challenges, Vail, Colo., 10-13 Aug. 1981
(Contract W-7405-ENG-48)
(DE82-000063; UCRL-86467; CONF-810838-2) Avail: NTIS HC A02/MF A01

To assess the impact of energy development in the western region of the Rocky Mountains, several space scales should be considered. The overall multistate region should be investigated from the view of baseline air quality and meteorology measurements. Results from a well designed and implemented baseline program would, in the future, be a valuable asset to answer critical questions about the air quality impact of energy development in this region. Modeling for an area this size (about 1000 km on a side) could wait until more reliable models are developed to address transport and diffusion on this scale in complex terrain. Also, studies on this scale require considerable resources and could be best handled by joint multiagency participation. For regions of approximately 200 km on a side, considerable research is presently underway by Federal agencies, universities, and private industry concerning atmospheric studies in complex terrain. DOE

**N83-16195#** Oak Ridge National Lab., Tenn.
**USDOE ACTIVITIES IN LOW-LEVEL RADIOACTIVE WASTE TREATMENT**
J. E. VATH 1981 19 p Presented at the Seminar on the Management of Radioactive Waste from Nucl. Power Plants, Karlsruhe (West Germany), 5 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-001450; IAEA-SR-57/42; CONF-811056-1) Avail: NTIS HC A02/MF A01

Current research, development and demonstration programs sponsored by the US Department of Energy in the area of low-level radioactive waste treatment are described. During the twelve month period ending September 30, 1981, 14 prime US Department of Energy contractors were involved with over 40 low-level radioactive waste disposal technology projects. Three specific projects or task areas were selected for discussion to illustrate new and evolving technologies, and application of technology developed in other waste management areas to low-level waste treatment. The areas to be discussed include a microwave plasma torch incinerator, application of waste vitrification, and decontamination of metal waste by melting. DOE

**N83-16256#** King Research, Inc., Rockville, Md.
**VALUE OF THE ENERGY DATA BASE**
DOE 31 Mar. 1982 85 p refs Sponsored by DOE
(DE82-014250) Avail: NTIS HC A05/MF A01

The Energy Information System is described. The value of the database is estimated. N.W.

# 02

# SOLAR ENERGY

Includes solar collectors, solar cells, solar heating and cooling systems, and solar generators.

**A83-10100**
**ON THE SURFACE RADIATION BUDGET**
R. T. PINKER (Maryland, University, College Park, MD) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1981, p. 1189-1194. refs
(Contract NOAA-NA-80AAD00048)

A study is being developed to evaluate the net gain or loss of radiant energy at the ground surface using data from satellite observations, which has relevance to problems related to regional climate trends, solar energy applications, and agriculture. Since information about these parameters is not available on a large scale, a methodology is being developed to infer these variables from satellite signatures. A model was developed which utilizes the high correlation that was found to exist between the net radiation and the total global solar radiation. In addition, an appropriate surface boundary layer model, compatible with the resolution of the satellite data, is being developed to compute sensible and latent heat fluxes. Preliminary results of experiments to compute the ground surface albedo for the Great Plains are presented and are found to be in good agreement with previously reported measurements. N.B.

**A83-10294**
**DIRECT-GAP GROUP IV SEMICONDUCTORS BASED ON TIN**
C. H. L. GOODMAN (Standard Telecommunication Laboratories, Ltd., Harlow, Essex, England) IEE Proceedings, Part I - Solid-State Electron Devices, vol. 129, pt. I, no. 5, Oct. 1982, p. 189-192. refs

The growth of thin films of tin with diamond structure of InSb and CdTe using molecular beam epitaxy under ultra high vacuum conditions is reported. It is determined that the photovoltaic behavior of the crystal suggests an energy gap of 0.12 eV, and the diamond structure of the tin layers is stabilized to about 70 C in contrast with 13 C for the bulk material. It is proposed that semiconductivity is a strain-induced splitting of the Groves-Paul degeneracy which has been taken to confer semimetallic behavior. An alternative, if less probable, explanation is also considered, in which the layer deposited by molecular beam epitaxy is free from Hg contamination and Hg could act as both donor (interstitial) and acceptor (substitutional), thus compensating to give quasi-gap-bridging impurity bands in an intrinsically semiconducting material. It is concluded that the band structure of the tin with diamond structure is of the G-P/B-B type, and that any energy gap is strain induced. N.B.

**A83-10428**
**SOLAR SATELLITES [SATELLITES SOLAIRES]**
C. POHER (Centre National d'Etudes Spatiales, Paris, France) L'Aeronautique et l'Astronautique, no. 95, 1982, p. 13-20. In French.

A reference system design, projected costs, and the functional concepts of a satellite solar power system (SSPS) for converting sunlight falling on solar panels of a satellite in GEO to a multi-GW beam which could be received by a rectenna on earth are outlined. Electricity transmission by microwaves has been demonstrated, and a reference design system for supplying 5 GW dc to earth was devised. The system will use either monocrystalline Si or concentrator GaAs solar cells for energy collection in GEO. Development is still needed to improve the lifespan of the cells. Currently, the cell performance degrades 50 percent in efficiency after 7-8 yr in space. Each SSPS satellite would weigh either 34,000 tons (Si) or 51,000 tons (GaAs), thereby requiring the

fabrication of a heavy lift launch vehicle or a single-stage-to-orbit transport in order to minimize launch costs. Costs for the solar panels have been estimated at $500/kW using the GaAs technology, with transport costs for materials to GEO being $40/kg. M.S.K.

**A83-10638**
**CW-LASER ANNEALED SOLAR CELLS**
S. MATSUMOTO, J. F. GIBBONS, and F. C. WU (Stanford University, Stanford, CA) Journal of Applied Physics, vol. 53, Oct. 1982, p. 7020-7025. refs
(Contract NSF DMR-78-19970)

A technique combining ion implantation and CW-laser annealing has been applied to fabricate solar cells in single-crystal, metallurgical grade (MG) polycrystalline, and Wacker-cast polycrystalline silicon materials, CW-laser processing can produce solar cells with a high fill factor in all materials used. The best AM1 conversion efficiencies for MG Si and Wacker-cast Si cells were 10.3% and 10.5%, respectively, without an antireflecting coating. (Author)

**A83-10699**
**ON THE FORMULA FOR THE UPPER LIMIT OF PHOTOVOLTAIC SOLAR ENERGY CONVERSION EFFICIENCY**
A. DE VOS, C. C. GROSJEAN, and H. PAUWELS (Gent, Rijksuniversiteit, Ghent, Belgium) Journal of Physics D - Applied Physics, vol. 15, Oct. 14, 1982, p. 2003-2015. refs

The formula for the maximum efficiency of photovoltaic energy conversion in tandem solar cells is discussed. This formula is obtained by the use of a thermodynamically founded diode I-V characteristic, and is compared to a previously published formula which was based on the classical diode I-V characteristic within the framework of the theory of Shockley and Queisser. Series expansions of the complicated efficiency formula are presented. They enable an easy and accurate computation of the maximum efficiency and provide more insight in the basic limit of the photovoltaic effect. (Author)

**A83-11007**
**MICROPROCESSOR CONTROL OF POWER SHARING AND SOLAR ARRAY PEAK POWER TRACKING FOR HIGH POWER /2.5 KW/ SWITCHING POWER CONVERTERS**
J. H SPEER, JR. (McDonnell Douglas Astronautics Co., Huntington Beach, CA) In: PESC '81; Power Electronics Specialists Conference, Boulder, CO, June 29-July 3, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 60-69.

A large deployable and recoverable solar array system and a series of high-efficiency power converters have been designed to supplement the power buses of the Shuttle Orbiter. Analog circuits are used for inner control loops and a microprocessor directs power sharing and peak power tracking. The tracking algorithm developed for the system permits operation right at the peak power point and actually searches continuously on both sides of this point without flattening the array. Hence, tracking of peak power can be accomplished through umbra and penumbra, through array degradation, temperature changes, and illumination changes due to array steering. In a prototype system, power sharing within 2% into the same load and an overall efficiency of 93.5% at 140 volt peak power point have been demonstrated. V.L.

**A83-11510#**
**STATUS OF NEW THIN-FILM PHOTOVOLTAIC TECHNOLOGIES**
K. W. MITCHELL (Solar Energy Research Institute, Golden, CO) In: Annual review of materials science. Volume 12. Palo Alto, CA, Annual Reviews, Inc., 1982, p. 401-415. refs

Some of the new thin film materials that show exceptional promise for photovoltaic applications are reviewed. These materials include copper indium diselenide, cadmium telluride, zinc phosphide, copper selenide, tungsten diselenide, and zinc silicon arsenide. The properties of the materials, the modes of deposition in thin films, and the photovoltaic parameters of thin film solar cells made of the materials are discussed. CdS/CuInSe2 and CdS/CdTe solar cells are shown in cross section. Other thin film solar cells are briefly described, including tungsten diselenide and ZnSiAs2, a ternary chalcopyrite compound with near optimum bandgap. C.D.

**A83-11696**
**DETERMINATION OF THE INTEGRAL CURRENTS OF SOLAR CELLS USING AN IMPROVED METHOD OF SPECTRAL SENSITIVITY MEASUREMENT [OPREDELENIE INTEGRAL'NYKH TOKOV SOLNECHNYKH ELEMENTOV S ISPOL'ZOVANIEM USOVERSHENSTVOVANNOI METODIKI IZMERENII SPEKTRAL'NOI CHUVSTVITEL'NOSTI]**
T. M. GOLOVNER, M. M. KOLTUN, A. L. KOSTANENKO, and I. S. ORSHANSKII Zhurnal Prikladnoi Spektroskopii, vol. 37, Sept. 1982, p. 471-475. In Russian. refs

A method is proposed for determining the short-circuit current of a standard solar cell under extraatmospheric illumination conditions by using a device based on a diffraction monochromator. Short-circuit currents determined from measured absolute spectral characteristics are in good agreement with field calibrations based on extrapolation to zero atmospheric mass. The proposed method is recommended for calibrating standard solar cells with various spectral response characteristics. V.L.

**A83-11764#**
**A STUDY OF SILICON AND GAAS SOLAR CELLS, AND THEIR OPTICAL COUPLING BY MEANS OF A DICHROIC MIRROR [ETUDE DES CELLULES SOLAIRES AU SILICIUM, AU GAAS, ET DE LEUR COUPLAGE OPTIQUE AU MOYEN D'UN MIROIR DICHROIQUE]**
O. SOUMAORO Toulouse III, Universite, Docteur (3e cycle) Thesis, 1982. 115 p. In French refs

The results of theoretical and experimental work to increase the efficiency of Si and GaAs solar cell concentrator assemblies by optical coupling with a dichroic mirror are presented. It is noted that the energy losses due to selective bandwidth in Si cells is near 23 percent, and thermal losses account for another 33 percent. The mechanisms which cause decreased efficiencies in solar cells are summarized and techniques for increasing the efficiency are reviewed. A numerical model is developed for the functioning of Si and GaAs solar cells in tandem operation. A device was fabricated using a Fresnel lens to concentrate sunlight into a rectangular channel cut diagonally front-to-back by a dichroic mirror. The back of the channel carried a Si cell, while the side was a GaAs cell. Cooling fins dispersed the thermal energy out the back of the channel. The Si cell displayed an 11 percent efficiency in the assembly, while the GaAs cell performed at 17 percent. M.S.K.

**A83-11766#**
**REFLECTIONS ON SOLAR COLLECTORS AT ELEVATED TEMPERATURES /260-1000 C/ [REFLEXIONS SUR LES COLLECTEURS SOLAIRES A TEMPERATURES ELEVEES /260-1000 C/]**
B. AUTHIER Aix-Marseille III, Universite, Docteur-es-Sciences Thesis, 1982, p. 1-42, 51-55, 63-69, 86-99, 107-112, 122-144, 150-175. In French and English. refs

Analytical models are developed for optical efficiencies and requirements of concentrating solar collectors, taking into account factors which affect the potentials for mass production. Reflective polyester films and a process to form large spherical mirrors from glass sheets have been crucial factors for lowering production costs. Microprocessors permit the nearly fully automated operation of parabolic dish point-focus and heliostat-central tower solar power plants, leaving only monitoring and maintenance for personnel. The use of GaAs-AsAl solar cells at the point focus of large spherical concentrators in the PERICLES project has yielded 22 percent energy conversion efficiences, although problems of cooling the cells have yet to be solved. Applications of the PERICLES concept for Indian village power supplies at 10 kWe/unit, while simultaneously supplying a drain hole at the center as a rainwater collection device, is described. M.S.K.

A83-11768#
**A METHODOLOGY OF EVALUATION AND DESIGN OF FIELDS OF FOCUSING HELIOSTATS [METHODOLOGIE D'EVALUATION ET DE CONCEPTION DE CHAMPS D'HELIOSTATS FOCALISANTS]**
J.-C. HENNET Toulouse III, Universite, Docteur d'Etat Thesis, 1982. 189 p. In French. refs

Numerical models for the representation of a field of focusing heliostats, for performance optimization, and for computer-aided design of heliostat fields are presented. A simplified global analysis is used, together with the physical properties of concentrated solar energy. Attention is given to design constraints caused by physics and economics, the efficiency, and the availability of the system. Precise quantification of the solar flux produced by the heliostat field is undertaken, regarding each reflected ray as a primary component surrounded by a conic envelope. Approximations are formulated for the effects of shade and blockage between the heliostats. A performance matrix is devised to predict annual output based on a branch and bound method. Finally, optimization is described in terms of a triangular-block structure and the performance matrix as bases for a parametric analysis. M.S K.

A83-11802
**SOLAR THERMAL ELECTRICITY GENERATION - EURELIOS, THE 1 MW/EL/ HELIOELECTRIC POWER PLANT OF THE EUROPEAN COMMUNITIES**
J. GRETZ (Commission of the European Communities, Joint Research Centre, Ispra, Italy) International Journal of Solar Energy, vol. 1, July 1982, p. 3-19. refs

A83-11803
**RECENT PROGRESS OF AMORPHOUS-SILICON SOLAR-CELL TECHNOLOGY IN JAPAN**
Y HAMAKAWA (Osaka University, Toyonaka, Japan) International Journal of Solar Energy, vol. 1, July 1982, p. 33-53. refs

A review is given of the current state of the art in Japanese domestic activities in amorphous silicon solar-cell R and D. The historical background and the present status of amorphous silicon solar-cell research in Japan are overviewed Some new approaches and key technologies to improve solar-cell performance with new amorphous materials such as a SiC.H, micro-c-Si:H, a-SiGe:H and heterojunction solar cells constructed of these materials are introduced Progress of the conversion efficiency in various types of amorphous-silicon solar-cells is surveyed and discussed. Recent features of the industrialization of a-Si photovoltaic cells in Japan are also reviewed, and future prospects are indicated. (Author)

A83-11811
**EXACTLY SOLUBLE MODEL FOR A SOLAR CELL WITH NONLINEAR RECOMBINATION**
M. CINI (Laboratori Tecnologie di Fisica Applicata, Rome, Italy) and G. FORTUNATO (Roma, Universita, Rome, Italy) Applied Physics Communications, vol. 1, no. 2, 1981-1982, p. 149-161. refs

A model is developed for obtaining an analytical solution of the nonlinear boundary problem for the current-voltage characteristics of a photovoltaic junction when the carrier recombination is taken to occur at localized centers. By choosing three centers in the different zones, a spatially uniform recombination process can be simulated. Different choices of the recombination centers are examined and their effect on the current-voltage characteristics is evaluated in dark and light exposed conditions. It is found that by using three discrete centers results are obtained that agree very closely with those of the continuous model N.B.

A83-11848
**DETERMINATION OF THE INTERFERENCE BETWEEN THE ELEMENTS OF A CENTRAL-RECEIVER SOLAR SYSTEM**
U. FACCHINI, G. SASSI (Milano, Universita, Milan, Italy), F PARRINI (Ente Nazionale per l'Energia Elettrica, Centro Ricerche Termiche Nucleari, Milan, Italy), and A. LONGHETTO (Torino, Universita; CNR, Istituto di Cosmogeofisica, Turin, Italy) Nuovo Cimento C, Serie 1, vol. 5C, Jan.-Feb. 1982, p. 84-98. Research supported by the Ente Nazionale per l'Energia Elettrica and Universita di Milano.

This work deals with the problem of determining the shadow and blocking effects between the rectangular heliostats of a central-receiver system for the utilization of solar energy. The type of approach followed is the McFee approach, suitably generalized. Indications are also given regarding the calculation of the density of radiation collected on a receiver assumed to be flat. (Author)

A83-11849
**MATHEMATICAL MODEL FOR A NONITERATIVE OPTIMIZATION OF EACH SYSTEM FOR EXPLOITING SOLAR ENERGY**
G. SASSI (Milano, Universita, Milan, Italy) Nuovo Cimento C, Serie 1, vol. 5C, Jan.-Feb 1982, p. 99-111. Research sponsored by Snamprogetti S.p A. and Ente Nazionale Idrocarburi. refs

In order to improve the solar-energy collection, whatever the adopted system may be, it is necessary to make ready a mathematical model which matches the astronomical co-ordinates and the geometric ones on the ground in a sole optimization process. The model here proposed permits such a determination in an analytical way, without utilizing iterative numerical methods, as done till now The proposed approach to the problem is carried out by using the solid analytic geometry. This means that the required mathematical development is quite brief; it refers to a central-receiver system so as to make it as general as posible, but it is immediately adaptable to any other system of exploiting solar energy. (Author)

A83-11991
**THEORETICAL TEMPERATURE DEPENDENCE OF SHORT-CIRCUIT CURRENT OF DRIFT-FIELD SOLAR CELLS**
K. CHIDA and S. MURAMATSU (Utsonomiya University, Utsunomiya, Japan) Solid-State Electronics, vol. 25, Oct. 1982, p. 1055, 1056. refs

A83-12029
**RESEARCH ON THE CHARACTERISTIC PARAMETERS OF THERMOPHOTOVOLTAIC /TPV/ CONVERTER PERFORMANCE**
M. AGNELLO, G. CASTAGNO, F. DEMICHELIS, E. MINETTI-MEZZETTI, and E. TRESSO (Torino, Politecnico, Turin, Italy) Nuovo Cimento B, Serie 11, vol. 71 B, Sept. 11, 1982, p 89-97. refs

The characteristic parameters and the problems involved in the realization of a thermophotovoltaic (TPV) converter have been investigated. Emitters of pure polycrystalline graphite appear the most convenient, since their emittance is high and they are easy to prepare Measurements of the practical efficiency of cells under TPV conditions have been made. (Author)

A83-12059
**PROCESS FOR HIGH PHOTOCURRENT IN IBC SOLAR CELLS**
F. W. SEXTON, C. M. GARNER, and J. L. RODRIGUEZ (Sandia National Laboratory, Albuquerque, NM) Electrochemical Society, Journal, vol. 129, Nov. 1982, p. 2624-2628. Research supported by the U.S. Department of Energy. refs

An interdigitated back contact solar cell fabrication process that yields cells with current-collection efficiencies in excess of 90% in n-type silicon is presented. This process maintains high bulk minority-carrier lifetime through the use of diffusion gettering steps and relatively low processing temperatures. Low front and back surface recombination velocities are achieved by growing thermal oxides on these surfaces followed by a forming gas anneal. Bulk lifetimes on the order of 350 microsec and front surface

recombination velocities of less than 30 cm/sec are determined by comparing measured quantum efficiency data to calculated quantum efficiency using an analytical code which solves the transport equations in one dimension. These lifetimes are compared to values of 290-190 microsec measured for cells with and without a front surface n(+) layer, respectively. These were measured with a laser scanning technique using the 514 nm wavelength and are considered a lower limit to the lifetimes. (Author)

**A83-12287**
**MEANING OF THE PHOTOVOLTAIC BAND GAP FOR AMORPHOUS SEMICONDUCTORS**
E. YABLONOVITCH, T. TIEDJE, and H. WITZKE (Exxon Corporate Research Laboratory, Linden, NJ) Applied Physics Letters, vol. 41, Nov. 15, 1982, p. 953-955. refs

The concept of a photovoltaic band gap for amorphous solar cells is introduced. This is the minimum photon energy thermodynamically required for the generation, of two free carriers in an operating solar cell For hydrogenated amorphous silicon the photovoltaic band gap is 1.57 eV at one sun illumination. (Author)

**A83-12290**
**SELF-ANNEALED ION IMPLANTED SOLAR CELLS**
E. GABILLI, R. LOTTI, P. G. MERLI, R. NIPOTI, and P. OSTOJA (CNR, Istituto LAMEL, Bologna, Italy) Applied Physics Letters, vol 41, Nov. 15, 1982, p. 967, 968. refs

First results for self-annealing implantation with dopant ions in the fabrication of solar cells are reported. The irradiations were performed using two different incidence angles The power densities and exposure times for the two cases are given. For the complete solar cells, carrier concentration and mobility profiles for the two implantation conditions are shown. The observed enhanced scattering effect, structural analysis, and transmission electron microscope observations show a high level of defects which affects the performance of the cells. The different implantation processes do not produce differences in the bulk lifetime values. The nonoptimized profile shape causes a low surface carrier concentration, affecting the front contact resistance of the cells, and also helps reduce performance The characteristics of the implanted layer and basic cell performance for each irradiation condition are shown. C.D.

**A83-12321**
**PROPERTIES OF AMORPHOUS SILICON SOLAR CELLS**
R. D. PLAETTNER, W. W. KRUEHLER, and M. MOELLER (Siemens AG, Forschungslaboratorien, Munich, West Germany) Siemens Forschungs- und Entwicklungsberichte, vol. 11, no. 5, 1982, p. 284-289. Research supported by the Bundesministerium fuer Forschung und Technologie. refs

Solar cells which are employed as power supplies for electrical systems and equipment must operate with high efficiency, remain mechanically and electrooptically stable over many years, and be reasonably priced. Thin-film solar cells consisting of hydrogenated amorphous silicon show great promise with respect to satisfying these requirements. In comparison to current cells made of bulk crystalline silicon, the fabrication of amorphous thin-film cells leads to a reduction in material consumption by a factor of 1000. A cost of about 1 DM per watt peak power for cells intended for exposure to optimum solar illumination is predicted. The main problem regarding solar cells of the considered design is related to a limitation in efficiency in connection with the high density of defect states in the amorphous material. However, the development of a procedure involving the use of hydrogen has made it possible to reduce this density. G.R.

**A83-12475*#** TRW, Inc., Redondo Beach, Calif
**OPTIMAL SUN-ALIGNMENT TECHNIQUES OF LARGE SOLAR ARRAYS IN ELECTRIC PROPULSION SPACECRAFT**
H. F. MEISSINGER, C. L. DAILEY (TRW, Inc., Space and Technology Group, Redondo Beach, CA), and M. E. VALGORA (NASA, Lewis Research Center, Cleveland, OH) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov. 17-19, 1982, AIAA 13 p refs
(Contract NAS3-22661)
(AIAA PAPER 82-1898)

Optimum sun-alignment of large solar arrays in electric propulsion spacecraft operating in earth orbit requires periodic roll motions around the thrust axis, synchronized with the apparent conical motion of the sun line. This oscillation is sustained effectively with the aid of gravity gradient torques while only a small share of the total torque is being contributed by the attitude control system. Tuning the system for resonance requires an appropriate choice of moment-of-inertia characteristics. To minimize atmospheric drag at low orbital altitudes the solar array is oriented parallel, or nearly parallel, to the flight direction. This can increase the thrust-to-drag ratio by as much as an order of magnitude. Coupled with optimal roll orientation, this feathering technique will permit use of electric propulsion effectively at low altitudes in support of space shuttle or space station activities and in spiral ascent missions (Author)

**A83-12596**
**OPTICAL ANALYSIS OF SOLAR ENERGY TUBULAR ABSORBERS**
C. SALTIEL and M. SOKOLOV (Tel Aviv University, Tel Aviv, Israel) *Applied Optics*, vol. 21, Nov. 15, 1982, p 4033-4039. refs

The energy absorbed by a solar energy tubular receiver element for a single incident ray is derived. Two types of receiver elements were analyzed: (1) an inner tube with an absorbing coating surrounded by a semi-transparent cover tube, and (2) a semitransparent inner tube filled with an absorbing fluid surrounded by a semitransparent cover tide. The formation of ray cascades in the semitransparent tubes is considered. A numerical simulation to investigate the influence of the angle of incidence, sizing, thickness, and coefficient of extinction of the tubes was performed. A comparison was made between receiver elements with and without cover tubes. Ray tracing analyses in which rays were followed within the tubular receiver element as well as throughout the rest of the collector were performed for parabolic and circular trough concentrating collectors. (Author)

**A83-12791*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THERMAL RESPONSE OF SOLAR RECEIVER APERTURE PLATES DURING SUN WALK-OFF**
L. WEN and J. ROSCHKE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, ASME 11 p. Research supported by the U.S. Department of Energy. refs
(ASME PAPER 82-HT-33) MEMBERS, $2.00; NONMEMBERS, $4.00

The tracking mechanism for a point-focusing concentrator may be subject to failure. If this should occur, the solar image will travel across the aperture plate, and it may also impinge on the adjacent support structure. Such an event is called 'sun walk-off'. The present investigation is concerned with the transient response of different aperture plate materials to the intense heating produced in a typical walk-off situation for parabolic dish concentrators. Receivers for two solar module systems are considered, including a high-temperature receiver that utilizes a 2-milliradian (mrad) concentrator, and a lower-temperature receiver which is coupled with a 4-mrad concentrator. It is found that during a walk-off situation the solar image travels in a straight line in the radial direction. The results obtained for a copper aperture plate were

disappointing. It appears that passive metallic plates without cooling or other protective support cannot withstand the intense heating G R.

**A83-12799#**
**THERMAL STORAGE PERFORMANCE CALCULATIONS BY CLOSED FORM AND FINITE DIFFERENCE SOLUTIONS**
M. E. TALAAT and E. COLUCCI (Maryland, University, College Park, MD) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, ASME 10 p.
(ASME PAPER 82-HT-52) MEMBERS, $2.00, NONMEMBERS, $4.00

It is shown that very close results are obtained when performance calculations are made for a liquid solar-thermal energy storage concept for continuous operation of an energy conversion system, either by using closed form solutions of the differential energy equation, or by using a computerized numerical solution based on a finite difference approximation of the differential energy equation, with each operating step subdivided into smaller increments. Typical deviation in storage temperatures calculated by the two methods at any given time is less than about 1 3 C, and the deviation in a typical thermal power load of 3600 W is less than about 5 W. It is also shown that the performance improves for larger storage systems. Output energy densities of about 77-85 kW-hr/cu m and solar collection-storage efficiencies of 42 to 46% are obtained with pressurized water and parabolic cylindrical collectors. (Author)

**A83-12800#**
**AN EXPERIMENTAL STUDY OF SINGLE MEDIUM THERMOCLINE THERMAL ENERGY STORAGE**
R. J. GROSS (Sandia National Laboratory, Albuquerque, NM) American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, 3rd, St. Louis, MO, June 7-11, 1982, ASME 8 p. refs
(Contract DE-AC04-76DP-00789)
(ASME PAPER 82-HT-53) MEMBERS, $2 00, NONMEMBERS, $4.00

Experiments were conducted on a 4.54 cu m single medium thermocline facility to determine the feasibility of the thermocline thermal energy storage concept on a large scale and to determine the relative importance of each of the five heat loss mechanisms present in such a system. The results of heat loss tests, static thermocline cool down tests and charge/discharge tests are presented. A simple one-dimensional model is proposed for the prediction of the temperature field during a cool down test in which a thermocline is present. The model agrees well with experiment. (Author)

**A83-12951**
**GLOBAL SOLAR RADIATION ESTIMATION FROM RELATIVE SUNSHINE HOURS IN ITALY**
A. ANDRETTA, B. BARTOLI, B. COLUZZI, V. CUOMO, M. FRANCESCA, and C. SERIO (Napoli, Universita, Naples, Italy) Journal of Applied Meteorology, vol 21, Oct. 1982, p. 1377-1384. refs

Available data on the global solar radiation are examined with respect to the insolation for Italy in order to evaluate errors in estimating the total radiation from the number of hours when the sun shines. The global data was gathered at 28 meteorological stations using pyranometers, while sunshine duration was assayed with heliographs. The global data was treated as monthly averages of global solar radiation on a horizontal surface and sunshine hours averaged over the period 1958-69. Additional sunshine duration measurements were taken at 70 other stations in Italy. A correlation of 0.796 was determined by linear regression between the ratios of available radiation outside the atmosphere and that available at the surface to the total number of sunshine hours divided by the total hours of measurement. A relation was formulated for estimations of the global radiation independent of season. M.S.K

**A83-13473#**
**THE INFLUENCE OF THE INTERFACE STATE ON THE PROPERTIES OF SOLAR CELL SEMICONDUCTOR ELECTRODES**
Z.-D LIN, P.-Z. ZHOU, Y.-Q CHEN, H.-G DENG, S -X. QI, C.-H. WANG, and K XIE (Chinese Academy of Sciences, Physics Institute, Beijing, People's Republic of China) Acta Physica Sinica, vol 31, Sept. 1982, p 1198-1205. In Chinese, with abstract in English. refs

The influence of interface state on electrode properties is studied for the case of an n-Fe2O3 film on an n-Si substrate which has undergone surface treatment to form a double layer semiconductor electrode Photoluminescence measurements show that an interface state with a high density of states lies above the 1 61-eV Fe2O3 valence band. The Fermi level is pinned by this interface state. Energy band profiles are used to explain the photoluminescence, in addition to theoretical calculation and analysis for the capacity-voltage and photocurrent-voltage curves. These curves are found to agree with experimental data. The present double layer semiconductor electrode is seen as a promising material for stable solar cells exhibiting high conversion efficiency. O.C.

**A83-13476*#** AiResearch Mfg. Co., Torrance, Calif.
**HIGH-TEMPERATURE CERAMIC HEAT EXCHANGER ELEMENT FOR A SOLAR THERMAL RECEIVER**
H. J. STRUMPF, D M. KOTCHICK, and M. G COOMBS (AiResearch Manufacturing Co , Torrance, CA) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p 305-309
(Contract NAS7-100; JPL-955875)

A study has been completed on the development of a high-temperature ceramic heat exchanger element to be integrated into a solar receiver producing heated air. A number of conceptual designs were developed for heat exchanger elements of differing configuration These were evaluated with respect to thermal performance, pressure drop, structural integrity, and fabricability The final design selection identified a finned ceramic shell as the most favorable concept The ceramic shell is surrounded by a larger metallic shell The flanges of the two shells are sealed to provide a leak-tight pressure vessel. The ceramic shell is fabricated by an innovative combination of slip casting the receiver walls and precision casting the heat transfer finned plates. The fins are bonded to the shell during firing. Fabrication of a one-half scale demonstrator ceramic receiver has been completed. (Author)

**A83-13477#**
**INTEGRATED SOLAR ENERGY SYSTEM OPTIMIZATION**
S. K. YOUNG (Science Applications, Inc., McLean, VA) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p 310-316. refs

The computer program SYSOPT, intended as a tool for optimizing the subsystem sizing, performance, and economics of integrated wind and solar energy systems, is presented. The modular structure of the methodology additionally allows simulations when the solar subsystems are combined with conventional technologies, e.g , a utility grid. Hourly energy/mass flow balances are computed for interconnection points, yielding optimized sizing and time-dependent operation of various subsystems The program requires meteorological data, such as insolation, diurnal and seasonal variations, and wind speed at the hub height of a wind turbine, all of which can be taken from simulations like the TRNSYS program. Examples are provided for optimization of a solar-powered (wind turbine and parabolic trough-Rankine generator) desalinization plant, and a design analysis for a solar powered greenhouse. M.S.K.

A83-13478#
**TRANSIENT PERFORMANCE OF EVACUATED TUBULAR SOLAR COLLECTORS**
M. J. BEHRENDORFF and R. I. TANNER (Sydney, University, Sydney, Australia) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p. 326-332. refs

A computer program using a finite difference technique is developed to study the steady-state and transient performance of an evacuated solar collector suitable for applications in the 120 - 250 C temperature region. The collector is modeled as an equivalent flat plate collector, with water, oil, and air being the heat transfer fluids studied in detail. Nonflow and laminar flow conditions are considered for the three fluids, together with turbulent flow for air. Step and sinusoidal solar inputs are modeled. Experimental transient tests on a module of evacuated collectors were made and were used to show that the accuracy of the theoretical model developed is adequate for design purposes (Author)

A83-13479#
**AN EXPERIMENTAL INVESTIGATION OF A STATIONARY REFLECTOR/TRACKING ABSORBER SOLAR COLLECTOR AT INTERMEDIATE TEMPERATURES**
E. FRUCHTER (Technion - Israel Institute of Technology, Haifa, Israel), F. KREITH (Solar Energy Research Institute, Golden, CO), and G. GROSSMAN ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p. 340-344. Research sponsored by the U S.-Israel Binational Science Foundation, and Ministry of Energy and Infrastructure of Israel refs
(Contract W-7405-ENG-26)

This paper describes the design, construction, and testing of a concentrating solar collector based on the Stationary Reflector/Tracking Absorber (SRTA) principle. The system consists of a fixed, 2.5-m diameter spherical mirror which focuses solar radiation on a movable, cylindrical absorber tracking the sun. This work is an extension of earlier tests with a similar collector in which output temperatures up to 150 C were obtained with water. The present system, using a mineral oil-based heat transfer fluid, was capable of heating the fluid up to 300 C under steady state conditions. The direct radiation efficiency ranged from 50% at low temperatures up to 30% near 300 C, showing the SRTA to be an effective concentrating collector for the intermediate temperature range which can be constructed at relatively low cost. (Author)

A83-13480#
**INCIDENT ANGLE MODIFIERS FOR FLAT-PLATE SOLAR COLLECTORS - ANALYSIS OF MEASUREMENT AND CALCULATION PROCEDURES**
W. C. THOMAS, A G DAWSON, III (Virginia Polytechnic Institute and State University, Blacksburg, VA), D. WAKSMAN, and E R. STREED (National Bureau of Standards, Center for Building Technology, Washington, DC) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p. 349-357. Research supported by the U.S. Department of Energy. refs

An investigation of the measuring procedures used to establish the angular response of four different types of solar flat-plate collectors is presented. The measurements indicated that substantial differences exist in accuracy and techniques among different laboratories. It was found that the collectors were sometimes measured at non-normal incidence angles, which caused uncertainties the same order of magnitude as efficiency reductions due to non-normal incidence angles. Additional uncertainty was introduced by the shading of the absorber by the end- and side-walls, producing decreases in absorptance of the same order of magnitude as decreases in transmissivity due to the cover assembly. A simple analytical model is developed to account for the off-normal incidence angles. A total effect of 5% is calculated for the incidence angle modifiers. M.S.K.

A83-13481#
**ANALYSIS OF TWO-PHASE FLOW SOLAR COLLECTORS WITH APPLICATION TO HEAT PUMPS**
S. K. CHATURVEDI, Y. F. CHIANG, and A. S. ROBERTS, JR. (Old Dominion University, Norfolk, VA) ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p. 358-365. refs

A thermodynamic model is developed to analyze the thermal performance of two-phase solar collectors. The well-known equilibrium homogeneous theory is used to model the two-phase flow in the solar collectors. The resultant set of coupled ordinary differential equations for saturated pressure and quality of working fluid in the collector tubes are solved by an iterative procedure using a fourth-order Runge-Kutta method. The results are then applied to determine the thermal performance of a solar assisted heat pump which uses two-phase flow collectors as the evaporator. The results indicate that even with the use of less expensive bare solar collectors as evaporator for the heat pump, the heating coefficient of performance (COP(H)) as high as 6 can be obtained under realistic ambient conditions provided a proper matching exists between the collector's evaporative capacity and the compressor's pumping capacity. (Author)

A83-13482*# Old Dominion Univ., Norfolk, Va.
**HYBRID THERMOELECTRIC SOLAR COLLECTOR DESIGN AND ANALYSIS**
A. S. ROBERTS, JR. (Old Dominion University, Norfolk, VA) and K. E. SHAHEEN ASME, Transactions, Journal of Solar Energy Engineering, vol. 104, Nov. 1982, p. 373-377. NASA-supported research. refs

A flat-plate solar collector is conceived where energy cascades through thermoelectric power modules generating direct-current electricity. The intent of this work was to choose a collector configuration and to perform a steady-state thermal performance assessment. A set of energy balance equations were written and solved numerically for the purpose of optimizing collector thermal and electrical performance The collector design involves finned columns of thermoelectric modules imbedded in the absorber plate (hot junction) over a parallel array of vertical tubes. The thermoelectric power output is limited by the small hot-junction/cold-junction temperature difference which can be maintained under steady-state conditions. The electric power per unit tube pass area is found to have a maximum as a function of a geometric parameter, while electric power is maximized with respect to an electric resistance ratio. Although the electric power efficiency is small, results indicate that there is sufficient electric power production to drive a coolant circulator, suggesting the potential for a stand-alone system. (Author)

A83-13501
**SOLAR CELL DEVICE PHYSICS**
S. J. FONASH (Pennsylvania State University, University Park, PA) New York, Academic Press, 1981. 348 p. refs
$35

A qualitative and quantitative exploration of the physical principles and operating characteristics of photovoltaic cells is presented. Solar cells experience a light-induced transition from a ground to an excited state, possess a transport mechanism to carry away the excited electrons or holes, and have properties which prevent the backward flow of electrons and holes. Attention is given to the electronic and optical properties of crystalline, polycrystalline, and amorphous solar cells, made from either organic or inorganic materials. The process of generation, recombination, and bulk transport are considered, together with the origins of photovoltaic activity in materials. Drift and diffusion, the two mechanisms for photocarrier collection in photovoltaics, are compared. Homojunctions, semiconductor-semiconductor heterojunctions, and surface-barrier devices are defined and quantitatively analyzed. Specific device configurations and experimental results are presented for each solar cell type described. M.S.K.

**A83-13580*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CALIBRATION OF SOLAR CELLS BY THE REFERENCE CELL METHOD - THE SPECTRAL MISMATCH PROBLEM**
C. H. SEAMAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Solar Energy, vol. 29, no. 4, 1982, p. 291-298. Research sponsored by the U.S. Department of Energy and NASA. refs

The calibration of solar cells by means of solar simulators and calibrated reference cells has always been faced with the problem of errors due to source spectral irradiance mismatch and cell spectral response mismatch. A general expression is derived in this paper to enable calculation of mismatch error. The information required to make this calculation is the relative spectra responses of the test and reference cells, and the relative spectral irradiance of the simulator (over the spectral range defined by cell response). The spectral irradiance of the solar standard is assumed given Experimental results are presented. (Author)

**A83-13581**
**LUMINESCENT SOLAR CONCENTRATORS - A REVIEW**
A. M. HERMANN (Solar Energy Research Institute, Golden, CO) Solar Energy, vol. 29, no. 4, 1982, p. 323-329 refs

Theoretical and cost considerations for the fabrication of luminescent solar concentrators (LSC) are discussed, along with the progress of research on the devices. The working principle consists of transparent material impregnated with randomly dispersed dye molecules which absorb photons at one wavelength and reemit them at longer wavelengths. Since the dyes are inside laminated plates, selectively reflective inner surfaces trap the reemitted light and eventually deposit it on solar cells mounted on the ends of the transparent plates. The maximum efficiency of an LSC plate coupled to Si solar cells is calculated to be 20%, and large array costs in 1986 have been projected to be on the order of $2.37/peak watt. AM1 efficiencies have been achieved with Coumarin 6 and Rhodamine 101 dyes. Efforts are proceeding to eliminate photodegradation in the dyes using inorganic chemicals. M.S.K.

**A83-13582**
**COLLECTION OF SOLAR ENERGY AT SPECIFIED OUTPUT TEMPERATURE**
H. S. ROBERTSON (Miami, University, Coral Gables, FL) and R. P. PATERA (Evansville, University, Evansville, IN) Solar Energy, vol. 29, no. 4, 1982, p. 331-337. refs

A theoretical examination of adjustment of the mass flow rate in a pumped-fluid solar collector to achieve a desired output temperature is presented. It is shown that there is no significant advantage to multiple passes through the collector to perform staged heating on the fluid. Consideration is also given to single-pass heating when the irradiance changes between passes, to series heating under changing irradiance, and one pass through two collectors. The analysis is based on use of the Hottel-Whillier equations. It is found that a mass flow rate is best chosen when the required fluid heating is accomplished in a single pass. The mass flow rate should be as rapid as practicable, with the fluid channels being small enough to ensure that the heating penetrates to the core of the fluid passing through the collector. M.S.K.

**A83-13583**
**A DESIGN METHOD FOR CLOSED LOOP SOLAR ENERGY SYSTEMS WITH CONCENTRATING COLLECTORS**
W. A. RYAN (Affiliated Engineers, Inc., Madison, WI) Solar Energy, vol. 29, no. 4, 1982, p. 355-357
(Contract E(11-1)-2588)

A method of performance prediction and design for closed loop concentrating solar collector systems is presented, along with a comparison of prediction with results using a compound parabolic concentrating collector. The numerical model is an extension of Collares-Pereira and Rabl (1978) model for concentrating collectors to a closed-loop scenario, using a monthly average utilizability factor and the f-chart technique. The predictions were compared with simulations using the TRNSYS program, considering 1.5, 3.0, and 5.0 concentration factors, and a sensible heat storage system Performance predictions were found to depart from the simulations by an average of 14.04% for all cases, with the predictions giving consistently lower results. The method is concluded to be useful for optimizing collector areas and concentration ratios in closed-loop systems. M.S.K

**A83-13647**
**PERFORMANCE CHARACTERISTICS OF 350 KW PHOTOVOLTAIC POWER SYSTEM FOR SAUDI ARABIAN VILLAGES**
B H. KHOSHAIM (Saudi Arabian National Center for Science and Technology, Riyadh, Saudi Arabia) International Journal of Solar Energy, vol. 1, no. 2, 1982, p. 91-103.

The program goals, design features, and preliminary performance data for a 350 kW concentrator solar cell array for powering a village in Saudi Arabia are outlined. Main design features include passive array cooling, tolerance of sandstorms and 40 kt winds, cleaning with a water jet, inverter output of 277/480 Vac, 3-phase current, stand alone operation, modular construction, minimum maintenance, and a lifetime of 20 yr. The photovoltaic array subsystem comprises 160 pedestal concentrator arrays with each array consisting of 256 2.25-in diam solar cells exposed to light transmitted through Fresnel lenses at a concentration of 33 suns. Details of the structure and tracking mechanisms are provided. A battery subsystem serves as a power source in the night, and is able to supply 1100 kWh down to 75% discharge Back-up power is furnished by four 250 kVA diesel generators. The system has thus far displayed an overall efficiency of 11.91%, in line with design goals. M.S.K.

**A83-13648*** Jet Propulsion Lab., California Inst of Tech., Pasadena
**POLYCRYSTALLINE SILICON AVAILABILITY FOR PHOTOVOLTAIC AND SEMICONDUCTOR INDUSTRIES**
R. R. FERBER, E. N. COSTOGUE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and R. PELLIN International Journal of Solar Energy, vol. 1, no. 2, 1982, p. 105-124. Research sponsored by the U.S. Department of Energy and NASA.

Markets, applications, and production techniques for Siemens process-produced polycrystalline silicon are surveyed. It is noted that as of 1982 a total of six Si materials suppliers were servicing a worldwide total of over 1000 manufacturers of Si-based devices. Besides solar cells, the Si wafers are employed for thyristors, rectifiers, bipolar power transistors, and discrete components for control systems. An estimated 3890 metric tons of semiconductor-grade polycrystalline Si will be used in 1982, and 6200 metric tons by 1985. Although the amount is expected to nearly triple between 1982-89, research is being carried out on the formation of thin films and ribbons for solar cells, thereby eliminating the waste produced in slicing Czolchralski-grown crystals. The free-world Si production in 1982 is estimated to be 3050 metric tons Various new technologies for the formation of polycrystalline Si at lower costs and with less waste are considered. New entries into the industrial Si formation field are projected to produce a 2000 metric ton excess by 1988 M.S.K.

**A83-13649**
**VALENCY CONTROL OF GLOW DISCHARGE PRODUCED A-SIC:H AND ITS APPLICATION TO HETEROJUNCTION SOLAR CELLS**
Y. HAMAKAWA and Y. TAWADA (Osaka University, Toyonaka, Japan) International Journal of Solar Energy, vol. 1, no. 2, 1982, p. 125-144. Research sponsored by the Ministry of Education and Ministry of International Trade and Industry. refs

A new type of amorphous silicon solar cell having a conversion efficiency of 8% level is introduced. The cell has a wide band gap window layer made of hydrogenated amorphous silicon carbide, (a-SiC·H), with a good valency control. Electrical, optical and optoelectronic properties of a-SiC·H have been investigated, together with their valency controllability. A design concept and some key technologies to improve solar cell performance with

this new material are demonstrated. A series of technical data on material preparation and cell performance are presented. Clear improvements in cell performance, not only I sub SC but also V sub OC, have been obtained. The realistic limit of the conversion efficiency in a-Si solar cells is estimated and discussed. (Author)

**A83-13677**
**REVIEW - SOLAR-GRADE SILICON**
B. R. BATHEY and M. C. CRETELLA (Mobil Tyco Solar Energy Corp, Waltham, MA) Journal of Materials Science, vol. 17, Nov. 1982, p. 3077-3096. refs

Various methods of manufacturing low-cost solar-grade silicon are reviewed. The methods include refining metallurgical-grade silicon, reduction of silicon compounds by metals and nonmetals, transport and thermal decomposition processes. The materials are briefly characterized by the chemical analysis, resistivity measurements and efficiency of solar cells obtained from them. (Author)

**A83-13697**
**THERMAL AND OPTICAL ANALYSIS OF AN EVACUATED CIRCULAR CYLINDRICAL CONCENTRATING COLLECTOR**
C. J. SALTIEL and M. SOKOLOV (Tel Aviv University, Tel Aviv, Israel) Solar Energy, vol. 29, no. 5, 1982, p. 391-396. refs

An evacuated concentrating circular cylindrical collector has been numerically investigated by ray tracing analyses. The optical efficiency of the collector is found by following incident rays onto the collector cover, calculating the amount of energy absorbed by the receiver for each ray, and then integrating the energy for all rays. Absorption and reflection losses in the collector materials are considered, as well as the formation of ray cascades. A thermal radiation exchange factor between the collector receiver and the cover, needed to find the thermal radiation losses, is also determined using ray tracing techniques. The collector overall efficiency was found for the case of a selective surface coating on the inner receiver cylinder and for the case of an absorbing fluid contained within a semi-transparent inner cylinder. The addition of a highly reflective thermal radiation coating of the inner surface of the cover, in order to suppress thermal radiation losses, was also evaluated. (Author)

**A83-13698**
**TRANSPORT OF SOLAR ENERGY WITH OPTICAL FIBRES**
J. M. CARIOU, J. DUGAS, and L. MARTIN (Toulouse III, Universite, Toulouse, France) Solar Energy, vol. 29, no. 5, 1982, p. 397-406. Research supported by the Centre National de la Recherche Scientifique. refs

In order to facilitate the use of concentrated solar energy its transport in optical fibres is studied Transmission properties of fibres as well as geometrical conditions of the association between fibres and concentrator are investigated. It is shown that modules where one fibre is associated with a small parabolic mirror may supply 2 W with an efficiency greater than 70 per cent, whilst the concentration on the exit end of a 10-m long fibre may exceed 3000. Such a device has been achieved and the experimental results are in good agreement with the preliminary study. Some further developments and interesting applications are indicated. (Author)

**A83-13699**
**OPTIMIZATION OF PARABOLIC TROUGH SOLAR COLLECTORS**
A. RABL (Solar Energy Research Institute, Golden, CO; Princeton, University, Princeton, NJ) , P. Bendt, and H. W. Gaul (Solar Energy Research Institute, Golden, CO). Solar Energy, vol. 29, no. 5, 1982, p. 407-417. Research supported by the Solar Energy Research Institute refs
(Contract EG-77-C-01-4047)

The results of a detailed optical analysis of parabolic trough solar collectors are summarized by a few universal graphs and curve fits. These graphs enable the designer of parabolic trough collectors to calculate the performance and optimize the design with a simple hand calculator. The method is illustrated by specific examples that are typical of practical applications. The sensitivity of the optimization to changes in collector parameters and operating conditions is evaluated. (Author)

**A83-13700**
**50 PER CENT MORE OUTPUT POWER FROM AN ALBEDO-COLLECTING FLAT PANEL USING BIFACIAL SOLAR CELLS**
A. CUEVAS, A. LUQUE, J. EGUREN, and J. DEL ALAMO (Madrid, Universidad Politecnica, Madrid, Spain) Solar Energy, vol. 29, no. 5, 1982, p. 419, 420.

**A83-13701**
**A METHOD OF RATING SOLAR COLLECTORS**
J P. KENNA (University College, Cardiff, Wales) Solar Energy, vol. 29, no. 5, 1982, p. 431-434

The difficulties faced by the consumer in evaluating the thermal performance of a collector are summarized. Whereas collectors can be classified in terms of the quantity of energy they provide in a reference solar heating system, the classification may not be applicable in other locations or for changes in system design It is shown that the thermal performance of collectors can be rated according to the normalized loss coefficient. The collector rating can then be used together with system performance prediction methods and economic and durability factors to decide upon the best collector for a given application. It is stressed that this normalized loss coefficient can be used to categorize solar collectors but not to compare them absolutely. C.R.

**A83-13702**
**POLYCRYSTALLINE P-WSE2 AS PHOTOCATHODE IN AN ELECTROCHEMICAL SOLAR CELL**
R. M. CANDEA (Institutul de Tehnologie Izotopica si Moleculara, Cluj, Rumania) and P STETIU (Institutul de Tehnologie Izotopica si Moleculara; Cluj, Universitatea, Cluj, Rumania) Solar Energy, vol. 29, no. 5, 1982, p. 435, 436. refs

Polycrystalline WSe2 photoelectrodes were formed by pressing a 99.99% pure compound of the elements into 1 mm thick disks under 1 billion N/sq m pressure at 300 K. A p-type conductivity was detected after the contacts were attached, as well as a Hall mobility of 540 sq cm/Vsec. Current-potential curves were obtained for operation in a homogeneous electrochemical cell under potentiostatic and potentiodynamic conditions, keeping the illumination above 0.4 microns and below the IR. An enhanced hydrogen production was produced by depositing a 50 A thick Ag layer on the electrode The cathodic photocurrent was three orders of magnitude less than that observed with monocrystalline WSe2. Tests were also performed with a wet junction solar cell configuration with Pt as the other electrode. The poor performance of the material is suggested to result from low surface quality, and further work on chemical pretreatment of the WSe2 photoelectrode surface is recommended. M.S.K

**A83-13743***
**GENERAL CONTAMINATION CRITERIA FOR OPTICAL SURFACES**
J. C. BREMER (ORI, Inc., Space Engineering Div., Silver Spring, MD) In: *Shuttle optical environment; Proceedings of the Meeting*, Washington, DC, April 23, 24, 1981. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1982, p. 10-19. refs
(Contract NAS5-25607)

Physical models are developed for establishing criteria to decide on the acceptable contamination level of optical devices in space-borne conditions. Optical systems can be degraded in terms of decreased throughput, i.e., transmissivity or reflectivity, or increases in the total integrated scatter (TIS). Performance losses can be caused by particulate accretion, molecular film accretion, and impact cratering. A quantitative relationship is defined for film thickness and loss of throughput. Formulas are also developed for cases where induced surface defects are larger than the desired viewing wavelengths, or smaller or of the same order of the observed wavelengths. The techniques are used to quantify the

degradation of a VUV solar coronagraph, a VUV stellar telescope, and a solar cell due to TIS. Applications are projected for estimating the contamination sensitivity of specific instruments, assessing the contamination hazard from known particulates, or to define clean room standards. M.S.K.

**A83-13807#**
**POWER CONDITIONING IN AN AUTONOMOUS SYSTEM CONTROLLED BY A MICROPROCESSOR SIMULATION OF USE WITH A PHOTOVOLTAIC GENERATOR [CONDITIONNEMENT DE PUISSANCE D'UN SYSTEME AUTONOME GERE PAR MICROPROCESSEUR - SIMULATION D'UNE UNITE A GENERATEUR PHOTOVOLTAIQUE]**
H. WINARNO Toulouse, Ecole Nationale Superieure d'Electrotechnique, Electronique, Informatique et Hydraulique, Docteur-Ingenieur Thesis, 1981. 112 p. In French. refs

A hybrid computer code is formulated to model the behavior of autonomous systems with a triangular structure when the power output is large and control is effected with a microprocessor. A previously developed model for dc-dc conversion is extended to the case of dc-ac conversion. Consideration is given to use of an INTEL 8085 chip, a 1 kWe concentrator photovoltaic system, a storage battery, and a resistive receiver. The model was divided into simulations of the power circuit and the circuit at a low level of control, thus allowing simulation of operations under partial commands. The simulation code is noted to reduce previous computer times for modeling such systems by a factor of 200. Additionally, the model is as effective with a series of power conditioners as it is with a sole unit. Simulations performed are representative of 10 msec sampling intervals with actual installations in real time. M.S.K.

**A83-13922*** University of Southern California, Los Angeles.
**OPTICAL ABSORPTION COEFFICIENT AND MINORITY CARRIER DIFFUSION LENGTH MEASUREMENTS IN LOW-COST SILICON SOLAR CELL MATERIAL**
R. T. SWIMM (Southern California, University, Los Angeles, CA) and K. A. DUMAS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Journal of Applied Physics, vol. 53, Nov. 1982, p. 7502-7504. Research sponsored by the U.S. Department of Energy refs
(Contract JPL-955612; NSF ECS-81-13428)

**A83-13923*** Case Western Reserve Univ , Cleveland, Ohio
**PLANAR MULTIJUNCTION HIGH VOLTAGE SOLAR CELL CHIP**
G. J VALCO, V. J. KAPOOR (Case Western Reserve University, Cleveland, OH), and J. C. EVANS, JR. (NASA, Lewis Research Center, Cleveland, OH) Journal of Applied Physics, vol. 53, Nov. 1982, p. 7566-7571. NASA-supported research. refs

A new innovative planar multijunction solar cell chip for concentrated sunlight applications is proposed. The chip consists of many voltage-generating regions, called unit cells, which are connected in series within a single silicon wafer, thereby providing a high open-circuit voltage at multiple sun illumination levels. The unit cells are fabricated on 75 micron thick p-type single crystal silicon substrate. Each chip consists of 1.42 x 9.63 mm n(+)/p collecting junctions on the back of the wafer, while the illuminated front surface area is divided into 0.3 micron deep n(+) regions. The fabrication sequence includes standard degreasing and cleaning procedures, double-sided alignment photomasking, introduction of boron and phosphorus impurities, and photolithography. The open circuit voltage of the chip increased rapidly with illumination up to about 4 AM1 suns, and then began to saturate at the sum of the individual unit cell voltages of 3.5 above 4 AM1 suns. A short circuit density per unit cell of 300 mA/sq cm at 20 AM1 suns was observed. C.D.

**A83-14109#**
**A STUDY OF DIFFERENT TECHNIQUES FOR COOLING SOLAR CELLS IN CENTRALIZED CONCENTRATOR PHOTOVOLTAIC POWER PLANTS [ETUDE DE DIFFERENTS PROCEDES DE REFROIDISSEMENT DES PHOTOPILES DANS LES CENTRALES PHOTOVOLTAIQUES A CONCENTRATION]**
J.-P. FORTEA Toulouse III, Universite, Docteur Ingenieur Thesis, 1981 164 p. In French. refs

Methods of cooling solar cells in concentrator assemblies in centralized power plants are examined with regard to feasibility, performance, and cost factors. The lowered efficiencies in Si, Ge, and GaAlAs-GaAs solar cells at elevated temperatures are noted, and the passive cooling system built into the mechanical architecture of the SOPHOCLE 1000 system is described. The cells were mounted on aluminum dissipators equipped with cooling fins. Second generation systems were investigated to achieve further cost reductions, and a numerical model was devised for the cooling operations. Passive coolers were found to be possible for GaAs concentrator assemblies with intensities of up to 500 suns, producing acceptable efficiencies Passive cooling is not, however, feasible for Si cells over 100 suns concentration for 4 sq cm cells, and 150 suns for 1 sq cm cells. Evaluations of forced air and phase change active cooling systems demonstrate that the phase change, using for example, water, permits substantial weight and cost savings, depending on the particular application. M.S.K.

**A83-14512**
**A NEW METHOD FOR EXPERIMENTAL DETERMINATION OF THE SERIES RESISTANCE OF A SOLAR CELL**
G. L. ARAUJO and E. SANCHEZ (Madrid, Universidad Politecnica, Madrid, Spain) IEEE Transactions on Electron Devices, vol. ED-29, Oct 1982, p. 1511-1513. refs

**A83-14513**
**A P-I-N HETEROJUNCTION MODEL FOR THE THIN-FILM CUINSE2/CDS SOLAR CELL**
A. ROTHWARF (Drexel University, Philadelphia, PA) IEEE Transactions on Electron Devices, vol. ED-29, Oct. 1982, p. 1513-1515. refs

By treating the high-resistivity CdS and CuInSe2 layers in high-efficiency cells as insulating, a simple p-i-n model results that predicts the behavior seen in these cells. The relatively low open-circuit voltage and the diode factor are both directly related to the width of the insulating CdS layer. Substantial improvements in both V sub OC and fill factor can be expected if the width of this CdS layer can be reduced. (Author)

**A83-14671#**
**EFFECT OF OFF-SOUTH ORIENTATION ON THE PERFORMANCE OF COLLECTOR REFLECTOR SYSTEM IN INDIA**
A. DANG and J. K. SHARMA (Indian Institute of Technology, New Delhi, India) Regional Journal of Energy, Heat and Mass Transfer, vol. 4, Oct. 1982, p. 271-283. refs

The effect of off-south orientation on the performance of a collector-reflector system is analyzed for two locations in India, New Delhi (L = 28 38 deg N) and Madras (L = 13.0 deg N). The enhancement of solar energy falling on the solar collector due to the use of the plane reflector is calculated as a function of the solar altitude and the azimuthal angles, the off-south orientation of the collector, and the relative sizes and tilt angles of both collector and reflector, while the amount of collector area shaded due to the presence of the reflector is considered. Results show that for a certain location, the instantaneous solar energy absorbed by a unit area of the collector is a function of the collector tilt with the horizontal, the reflector tilt with the horizontal, the relative sizes of the reflector and the collector, and the off-south angle. The conditions for the maximum solar energy absorbed per unit area of collector for the twelve average days in the year for the two locations are presented in graphical form. N.B.

A83-15130
**TESTING OF THE ENERGY MODULE OF A PARABOLOCYLINDRICAL SOLAR INSTALLATION [ISPYTANIIA ENERGETICHESKOGO MODULIA SOLNECHNOI PARABOLOTSILINDRICHESKOI USTANOVKI]**
B. V. TARNIZHEVSKII, I. I. KOKHOVA, S. N. ALIEV, V. A. SAMOILOV, and S. F. ERGASHEV (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) Geliotekhnika, no 5, 1982, p. 19-23. In Russian.

The paper presents results of full-scale tests of the operation of the energy module of a parabolocylindrical solar installation with a heat pipe at working temperatures to 300 C The tests included: investigation of the behavior of the heat pipe under heating by nonuniform concentrated solar flux; examination of the operating modes of the heat pipe; determination of the energy characteristics of the module; assessment of the time lag of the module; and testing of the parabolocylindrical module with a thermoelectric generator. The results which are presented include typical curves of change of solar radiation and heat-pipe temperature, as well as plots of experimental profiles of the heat-pipe wall temperature, and energy characteristics of the

A83-15131
**AUTOMATIC METHODS FOR THE ADJUSTMENT OF FACETED SOLAR-ENERGY CONCENTRATORS AND HELIOSTATS [AVTOMATICHESKIE METODY IUSTIROVKI FATSETNYKH KONTSENTRATOROV I GELIOSTATOV SOLNECHNOI ENERGII]**
R. A. ZAKHIDOV, R. A. KHAKIMOV, A. A. ABDURAKHMANOV, IU. M. SIZOV, and V. K BARANOV (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR) Geliotekhnika, no. 5, 1982, p. 23-26. In Russian.

An automatic adjustment technique is described which makes possible a considerable simplification of the operation of solar-energy installations. Diagrams of devices for the automatic adjustment of the facets of a composite concentrator and of a plane heliostat are presented. An error analysis shows that the accuracy of the adjustment method is 4-5 arcmin. B.J.

A83-15132
**THERMAL ENERGY STORAGE UNITS FOR SOLAR ELECTRIC POWER PLANTS [AKKUMULIATORY TEPLOVOI ENERGII DLIA SOLNECHNYKH ELEKTROSTANTSII]**
V. I. GUDKOV and K. N. CHAKALEV (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR) Geliotekhnika, no. 5, 1982, p. 27-31. In Russian. refs

Several types of heat storage units for solar power plants with thermodynamic cycles of energy conversion are examined, including specific-heat units (particularly water-vapor devices), thermochemical units, and phase-change units. The dependence of specific capital costs for heat storage units upon time of operation is discussed, and particular consideration is give to types of connections of specific-heat units into the thermal circuit of a power plant, and to a phase-change unit that uses a heat pipe for internal heat transport. B.J.

A83-15133
**INVESTIGATION OF THE EQUATIONS OF MOTION OF THE HELIOSTATS OF A TOWER-TYPE SOLAR ELECTRIC POWER PLANT [ISSLEDOVANIE URAVNENII DVIZHENIIA GELIOSTATOV SOLNECHNOI ELEKTRICHESKOI STANTSII BASHENNOGO TIPA]**
M. N. KACHANOVSKII and V. M. DUBILOVICH (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Belorussian SSR) Geliotekhnika, no. 5, 1982, p. 31-35. In Russian.

A83-15135
**REGULATION OF THE DIURNAL VARIATION OF THE COLD PRODUCTIVITY OF AN ADSORPTION-TYPE SOLAR REFRIGERATION SYSTEM [REGULIROVANIE SUTOCHNOGO GRAFIKA KHOLODOPROIZVODITEL'NOSTI ABSORBTSIONNOI KHOLODIL'NOI SOLNECHNOI USTANOVKI]**
O. KLYSHCHAEVA, A. KAKABAEV, and G. REDZHEPOV (Akademiia Nauk Turkmenskoi SSR, Nauchno-Proizvodstvennoe Ob'edinenie Solntse, Ashkhabad, Turkmen SSR) Geliotekhnika, no. 5, 1982, p. 44-50. In Russian.

The paper examines various modes of operation of an adsorption-type solar refrigeration system, which make it possible to extend the operation of the system, which make it possible to extend the operation of the system to periods when there is no sunlight. It is shown that the diurnal variation of cold productivity can be determined through the establishment of the time variation of the water content of the solution. Cold-productivity plots are presented for characteristic modes of operation of the system. Consideration is given to the mode of operation where the period of operation of the refrigeration part coincides with the period of sunlight. B.J

A83-15136
**CONCERNING THE IMPROVEMENT OF SOLAR HEATING AND COOLING SYSTEMS [K VOPROSU SOVERSHENSTVOVANIIA SISTEM SOLNECHNOGO TEPLOKHLADOSNABZHENIIA]**
IU. K. RASHIDOV (Tashkentskii Zonal'nyi Nauchno-Issledovatel'skii Institut Eksperimental'nogo Proektirovaniia Zhilykh i Obshchestvennykh Zdanii, Tashkent, Uzbek SSR) Geliotekhnika, no. 5, 1982, p. 68-73. In Russian refs

It is suggested that systems of solar heating and cooling can be simplified by the use of 'organized hydrothermal processes' (OHP) in the elements (e.g., circulation systems and heat storage units) of such systems. This paper defines and classifies such processes. Design diagrams are presented for two types of systems: (1) a heating, hot-water, and storage system with one-phase OHPs; and (2) a gravity-assisted heat pipe and an adsorption-type solar refrigeration system with two-phase OHPs. B.J.

A83-15371* Houston Univ., Tex.
**REFRACTORY RESIDUES, CONDENSATES AND CHONDRULES FROM SOLAR FURNACE EXPERIMENTS**
E. A. KING (Houston, University, Houston, TX) In: Lunar and Planetary Science Conference, 13th, Houston, TX, March 15-19, 1982, Proceedings. Part 1. Washington, DC, American Geophysical Union, 1982, p. A429-A434 refs
(Contract NAGW-178)

Vertical access solar furnace experiments have produced refractory residues, condensates and chondrules that are similar to components of chondritic meteorites. In particular, Ca-Al-rich refractory residues similar in chemistry to inclusions in carbonaceous chondrites have been produced by partial evaporation of basaltic bulk rock samples. Fe-Mg-Si-rich condensates with distinctive microbotryoidal morphology have been collected from the same sample runs. Particle coatings and aggregates with virtually identical microbotryoidal morphology and major element chemistry have been identified in both the Allende and Murchison meteorites. Spattered drops from melt beads undergoing heating and partial evaporation resemble some meteoritic chondrules in their mineralogies, textures, grain size, and sorting. The spatter mechanism is highly efficient in the production of chondrules. If any of the refractory inclusions in chondrites are, in fact, partial evaporation residues, many meteoritic fluid drop chondrules must have been formed by this process. The hot central portion of the solar nebula, acting on a cloud of dust and gas, is the probable source of heat required to produce the fractionated chemistry and physical state of many of the components of chondritic meteorites. (Author)

**A83-15452**
**COMMERCIAL PHOTOVOLTAICS MEASUREMENTS WORKSHOP, VAIL, CO, JULY 27-29, 1981, PROCEEDINGS**
S. HOGAN, (ED.) (Solar Energy Research Institute, Golden, CO) and H. A. SCHAFFT (National Bureau of Standards, Washington, DC) Workshop sponsored by the U.S. Department of Energy Solar Cells, vol. 7, Nov. 1982 211 p.

Various topics in the area of commercial photovoltaics measurements are discussed. The topics considered include: the status of measurements for commercial photovoltaics; a manufacturer's perspective of measurement equipment needs for the photovoltaics industry; the use of test structures in the production of CdS/Cu2S photovoltaic devices; the Semiconductor Equipment and Materials Institute specification for solar cell silicon, the role of impurities in silicon solar cell performance; spectroradiometer measurements in support of photovoltaic device testing Also addressed are. the calibration of pyrheliometers and pyranometers for testing photovoltaic devices; progress in the development of standard procedures for the global method of calibration of photovoltaic reference cells; status and perspectives of photovoltaic systems measurements, the use of measurements to detect electrical problems in operational photovoltaic arrays; experience with specifications applicable to certification; development of a standard test method for measuring photovoltaic cell performance. C.D.

**A83-15454**
**A MANUFACTURER'S PERSPECTIVE OF MEASUREMENT EQUIPMENT NEEDS FOR THE PHOTOVOLTAICS INDUSTRY**
W. R. BOTTENBERG (ARCO Solar, Inc., Chatsworth, CA) (U S. Department of Energy, Commercial Photovoltaics Measurements Workshop, Vail, CO, July 27-29, 1981 ) Solar Cells, vol. 7, Nov 1982, p. 51-54.

The photovoltaics industry has developed and is still developing unique needs for inspection and measurement tools and techniques. In some areas, equipment and working systems are in place for the present but, in most places, existing tools are inadequate for the present industry. Standards and material specifications remain to be created. For future industry growth a great deal of work must be done to support incoming material inspection, process control and product inspection and testing. (Author)

**A83-15455**
**USE OF TEST STRUCTURES IN THE PRODUCTION OF CDS/CU2S PHOTOVOLTAIC DEVICES**
E. D. CASTEL and M. J. SOUBEYRAND (Photon Power, Inc., El Paso, TX) (U.S. Department of Energy, Commercial Photovoltaics Measurements Workshop, Vail, CO, July 27-29, 1981.) Solar Cells, vol. 7, Nov. 1982, p. 69-72.

The usefulness of a test structure as a tool in the manufacture of large-area CdS/Cu2S solar cell arrays is shown. The electrical parameters measured on the test structure are presented as an isometric density plot which yields a global image of the photovoltaic quality of the substrate used. (Author)

**A83-15457**
**ROLE OF IMPURITIES IN SILICON SOLAR CELL PERFORMANCE**
N. G. SAKIOTIS (Motorola, Inc., Semiconductor Group, Phoenix, AZ) (U.S. Department of Energy, Commercial Photovoltaics Measurements Workshop, Vail, CO, July 27-29, 1981.) Solar Cells, vol. 7, Nov. 1982, p 87-96. refs

The effects and tolerable quantities of impurities in solar cells are discussed. Attention is given to metallic and oxygen impurities which are shown, from experimental results, to have an acceptable concentration level between 1-100 trillion atoms/cu cm. The types and magnitudes of impurities introduced into solar cells during fabrication steps are quantified. It is noted that control of the impurity levels on the scale required is not possible with present techniques, but can be implemented through monitoring of key performance parameters such as the bulk minority carrier diffusion length, the open-circuit voltage, and junction-voltage characteristics. The methods would be applied to qualifying and inspecting the initial substrates and also on-line quality control during cell fabrication. M.S.K

**A83-15458**
**SPECTRORADIOMETER MEASUREMENTS IN SUPPORT OF PHOTOVOLTAIC DEVICE TESTING**
G. A. ZERLAUT and J. D. MAYBEE (DSET Laboratories, Inc., Phoenix, AZ) (U.S. Department of Energy, Commercial Photovoltaics Measurements Workshop, Vail, CO, July 27-29, 1981.) Solar Cells, vol. 7, Nov. 1982, p. 97-106.

The spectroradiometer is capable of complete solar spectral measurements approximately 7 min apart in both the global and the direct beam modes, all in the wavelength range 280-2500 nm. Global measurements can be made at any azimuth and altitude position, the field of view of the pyrheliometer comparison tube is 6 deg Typical spectra show that the resolution is sufficient to identify Fraunhofer absorption bands in the surface of the sun. Data are presented that show the relationship between direct beam spectra and two specific microenvironments. The differences observed are analyzed in terms of the significance of microenvironment haze and pollution to the efficiency of concentrating photovoltaic devices. (Author)

**A83-15461**
**PHOTOVOLTAIC SYSTEMS MEASUREMENTS - STATUS AND PERSPECTIVES**
R DEBLASIO (Solar Energy Research Institute, Golden, CO) (U.S. Department of Energy, Commercial Photovoltaics Measurements Workshop, Vail, CO, July 27-29, 1981.) Solar Cells, vol 7, Nov. 1982, p. 159-163.

An account of the present status of, and trends toward, photovoltaic systems standards by the IEEE Photovoltaic Systems Standards Committee is given. Photovoltaic systems measurement consensus standards projects are detailed and future needs are discussed. (Author)

**A83-15463*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**EXPERIENCE WITH SPECIFICATIONS APPLICABLE TO CERTIFICATION**
R. G. ROSS, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) (U.S Department of Energy, Commercial Photovoltaics Measurements Workshop, Vail, CO, July 27-29, 1981.) Solar Cells, vol. 7, Nov. 1982, p. 197-201.

The Jet Propulsion Laboratory has developed a number of photovoltaic test and measurement specifications to guide the development of modules toward the requirements of future large-scale applications. Experience with these specifications and the extensive module measurement and testing that has accompanied their use is examined. Conclusions are drawn relative to three aspects of product certification: performance measurement, endurance testing and safety evaluation. (Author)

**A83-15476**
**RAPID SIMULATED SOLAR ABSORPTANCE MEASUREMENTS ON FLAT OR CURVED SURFACES**
G. L. HARDING, M. LAKE, S. CRAIG, and B. WINDOW (Sydney, University, Sydney, Australia) Solar Energy Materials, vol. 7, Sept.-Oct. 1982, p. 129-137. Research supported by the University of Sydney and Science Foundation for Physics. refs

The construction of an instrument to determine the solar absorptances of surfaces within one minute is described. Values of absorptance measured for highly specular and diffusely reflecting absorbing surfaces agree within 0.01 with values of AM2 absorptance calculated from reflectance vs. wavelength data. Techniques are described where the instrument may be calibrated for measurement of absorptance of selective surfaces enclosed within concentric tubular collectors. (Author)

A83-15479
**BLACK CHROME SOLAR SELECTIVE COATINGS OPTIMIZED FOR HIGH TEMPERATURE APPLICATIONS**
R. B. PETTIT, R. R. SOWELL, and I. J. HALL (Sandia National Laboratory, Albuquerque, NM) Solar Energy Materials, vol. 7, Sept.-Oct. 1982, p. 153-170. refs
(Contract DE-AC04-76DP-00789)

Results of an investigation into the variables observable in the process of electrodeposition of black chrome coatings for solar selective surfaces to predict the thermal stability of the coatings are presented. Attention was given to the bath composition, the plating current density, the bath temperature, the substrate, and the plating time, with performance assessed in terms of the solar absorptance values, as well as the emittance. Accelerated thermal aging tests were performed on the specimen plates. Low concentrations of chromium and addition agents in the bath produced the most stable coatings, which displayed emittance values of 0.17-0.18 after heating to 300 C. Adding silver oxide to the plating bath reduced the chloride ion concentration, and increased the thermal stability of the coating. The best coatings displayed less than 1% decrease in absorptance after 40 hr at 450 C, and the same value only after 5600 hr at 350 C. A detailed process specification is provided, including such manufacturing steps as surface preparation and rinsing procedures M.S.K

A83-15480
**POLYCRYSTALLINE LANTHANUM RHODATE AND LUTETIUM RHODATE PHOTOELECTRODES FOR LIQUID JUNCTION SOLAR CELLS**
M. ZAFRIR, M. HALMANN, and B. AURIAN-BLAJENI (Weizmann Institute of Science, Rehovot, Israel) Solar Energy Materials, vol 7, Sept.-Oct. 1982, p. 171-181. Research supported by the Ministry of Energy and Bundesministerum fuer Forschung und Technologie. refs

A83-15482
**OPTICAL PROPERTIES OF GOLD-MAGNESIA SELECTIVE CERMETS**
D. MAZIERE-BEZES and J. VALIGNAT (Commissariat a l'Energie Atomique, Laboratoire d'Etudes des Materiaux Minces, Grenoble, France) Solar Energy Materials, vol. 7, Dec. 1982, p. 203-211. refs

The deposition of homogeneous Au-MgO selective cermets on solar collector surfaces by dc reactive cosputtering is described, together with an assessment of the solar activity of the materials. A commercial planar magnetron device was employed with argon as the working gas and oxygen as the reacting gas. The surfaces were deposited on glass slides, and polished copper, and carbon films were sputtered onto copper grids and copper wafers. A high metallic content was found to be necessary to produce satisfactory solar absorptance with the Au-MgO cermet. The temperature of the substrate and the deposition technique were found to be significant factors during manufacturing. More precise examinations are recommended in order to successfully develop a theoretical model for the cermet-surfaced solar selective surface. M.S.K

A83-15483* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**LAYERED TRANSITION METAL THIOPHOSPHATES /MPX3/ AS PHOTOELECTRODES IN PHOTOELECTROCHEMICAL CELLS**
C. E. BYVIK (NASA, Langley Research Center, Hampton, VA), B. T. SMITH, and B. REICHMAN (Christopher Newport College, Newport News, VA) Solar Energy Materials, vol. 7, Sept.-Oct. 1982, p. 213-223. refs

Layered crystals of the transition metal thiophosphates were synthesized and characterized for use as photoelectrodes in photoelectrochemical cells. Crystals incorporating tin and manganese show n-type response while those with iron and nickel show p-type response. These materials have a measured indirect bandgap of about 2.1 eV. They show ability to photoelectrolyze water in acid solutions with onset potentials which change in a Nernstian way as the PH of the solution changes. The onset potential is near zero volts versus a saturated calomel electrode at pH 2. At n-type crystals, oxygen could be evolved upon irradiation at underpotentials of 850 mV and at p-type crystals, hydrogen could be evolved at underpotentials of 400 mV, indicating a net gain in energy conversion. All crystals were unstable in basic solution Liquid junction photovoltaic cells in iodide-triiodide acid solution using these layered materials were also constructed and found to have low efficiences. (Author)

A83-15488
**SPECTRAL SELECTIVITY OF HIGH-TEMPERATURE SOLAR ABSORBERS. II EFFECTS OF INTERFERENCE**
D. M. TROTTER, JR and A. J SIEVERS (Cornell University, Ithaca, NY) Solar Energy Materials, vol. 7, Dec. 1982, p. 281-289. refs
(Contract DE-FG02-80CS-83113; NSF DMR-76-81083)

Previous numerical calculations of the normal incidence solar absorptivity alpha-s of model spectrally selective solar absorbers are extended to include fully graded layers with small index mismatches to free space at their front surfaces. If the magnitude of the mismatch and the thickness of the layer are properly chosen, the resulting interference effects allow formation of thin (approximately 2500 A) layers with alpha-s values comparable with those found in much thicker fully graded layers continuous at the layer-free space interface. The thermal emissivities of these thinner layers are expected to be similar to those of thicker layers having the same alpha-s. (Author)

A83-15490
**THE OPTICAL PROPERTIES OF TITANIUM NITRIDES AND CARBIDES SPECTRAL SELECTIVITY AND PHOTOTHERMAL CONVERSION OF SOLAR ENERGY**
L. ROUX, J. HANUS (Aix-Marseille II, Universite, Marseille, France), J. C. FRANCOIS, and M. SIGRIST (Aix-Marseille I, Universite, Marseille, France) Solar Energy Materials, vol. 7, Dec. 1982, p. 299-312. refs

A83-15492
**LARGE GRAIN POLYCRYSTALLINE SILICON FROM RICE HUSK**
D. N. BOSE, P. A. GOVINDACHARYULU, and H. D. BANERJEE (Indian Institute of Technology, Kharagpur, India) Solar Energy Materials, vol. 7, Dec. 1982, p. 319-321. Research supported by the Ministry of Science and Technology. refs

Rice-husk may constitute a viable alternative raw material for production of solar grade silicon Powdered silicon obtained by Mg reduction of rice-husk ash was subjected to melting and directional solidification resulting in large-grain polycrystalline silicon ingots. The material was found to be p-type with resistivity 0.1-0.3 ohm-cm within the grains The hole concentration was 8 x 10 to the 17th/cu cm and mobility 69 sq cm/VS as found from Hall effect studies. Steady-state photoconductivity indicated electron life-times greater than one-millionth of a second which is promising for photovoltaic applications. The conductivity activation energy of 0.045 eV showed that B was the active impurity. (Author)

A83-15493
**OXYGEN EVOLUTION IMPROVEMENT AT A CR-DOPED SRTIO3 PHOTOANODE BY A RU-OXIDE COATING**
P. SALVADOR, V. M FERNANDEZ (Consejo Superior de Investigaciones Cientificas, Instituto de Catalisis y Petroleoquimica, Madrid, Spain), and C. GUTIERREZ (Consejo Superior de Investigaciones Cientificas, Instituto de Quimica-Fisica, Madrid, Spain) Solar Energy Materials, vol 7, Dec. 1982, p. 323-329. Research supported by the U.S.-Spain Program of Cultural Cooperation. refs

The performance for water photo-oxidation of a Cr-doped SrTiO3 photoanode coated with a Ru-oxide film is studied. The experimental results, which are interpreted in terms of a two-interface model, could support those previously obtained with RuO2-coated, colloidal CdS microelectrodes. This seems to open new perspectives in the stabilization of photocorrosion prone electrodes for solar energy conversion. (Author)

A83-15496
**ON THE PROPERTIES OF THE SUPERPLASTIC ALUMINIUM-CALCIUM ALLOY AS MATERIAL FOR SOLAR COLLECTORS**
G PELLEGRINI, P. BRUGHERA, and F. QUAZZO (Commission of the European Communities, Joint Research Centre, Ispra, Italy) Solar Energy Materials, vol. 7, Dec. 1982, p. 351-357. refs

The aluminum-calcium alloy of eutectic composition (7.5 wt% Ca) combine superplastic with selective optical properties It possesses a low emissivity in the infrared around 85 C and an absorption peak in the visible at wavelengths between 700 and 900 nm. Anodization of the alloy produces a homogeneous protective film light gray of color. Anodized alloy specimens exposed to solar irradiations under a vacuum of 0.01 mm Hg reach temperatures not very far from those obtained using conventional selective coatings. (Author)

A83-15497
**AN INVESTIGATION OF DEPOSITION PARAMETER DEPENDENCE OF OPTICAL PROPERTIES, MICROSTRUCTURE AND THERMAL STABILITY OF BLACK CHROME SELECTIVE SURFACES**
J C. MABON, O. T. INAL, and A J SINGH (New Mexico Institute of Mining and Technology, Socorro, NM) Solar Energy Materials, vol. 7, Dec. 1982, p. 359-376. U S. Department of Energy refs
(Contract DOE-78-04-4226)

A83-15499
**INFLUENCE OF DEPOSITION RATE ON THE CHARACTER OF ELECTRODEPOSITED CDSE USED FOR PHOTOELECTROCHEMICAL CELLS**
R A. BOUDREAU and R. D. RAUH (EIC Laboratories, Inc., Newton, MA) Solar Energy Materials, vol. 7, Dec. 1982, p. 385-391. refs
(Contract XP-9-8002-7)

The electrodeposition of CdSe from aqueous solutions containing Cd(2+) and SeO2 under acidic conditions results in the formation of films useful in photoelectrochemical solar cells. For given concentrations of reagents, a rather narrow range of current densities are specified to prevent formation of separate islands of Cd or Se. Electrolyte compositions enabling high deposition rates produce the most active layers, but films deposited at high rates often result in inhomogeneous deposits of separated Cd and Se when irregular substrate shapes are used. A photoelectrochemical cell conversion efficiency of 6.7% was achieved at 80 mW/sq cm tungsten-halogen white light intensity for CdSe electroplated on Ti in contact with an aqueous polysulfide electrolyte. (Author)

A83-15509
**SCHOTTKY REVISITED**
H. K. HENISCH, J. W. PARK (Pennsylvania State University, University Park, PA), J.-C. MANIFACIER, and Y. MOREAU (Pennsylvania State University, University Park, PA; Montpellier II, Universite, Montpellier, France) Solar Energy Materials, vol. 8, Nov. 1982, p. 91-100. refs

The present investigation is concerned with the characteristics of the Schottky model, taking into consideration also unsolved difficulties and limits regarding the application of the model Two aspects not satisfactorily handled are related to the notion of charge continuity and the problem of electronic space charges. Difficulties also arise in the analysis of composite barriers. In connection with model applications, it must be taken into account that the Schottky model is strictly a single carrier model. Accordingly, it is quite wrong to accept its predictions for systems which involve holes as well as electrons. Nor is modification of the model simple, because such a modification cannot be achieved by analytic means. The transport relationships in many contact systems (e.g., solar cells) become analytically insoluble, and the exploration of the involved problems by computer techniques is inevitable. The relationships are generally too involved to permit intuitive predictions of the results. G R.

A83-15510
**RECENT ADVANCES IN AMORPHOUS SILICON SOLAR CELLS**
Y. HAMAKAWA (Osaka University, Toyonaka, Japan) Solar Energy Materials, vol. 8, Nov. 1982, p. 101-121. refs

The advantages, device physics, research efforts, and the state-of-the-art in amorphous Si solar cells are discussed. Studies have shown that an optimal device thickness of 0.5-0.7 micron would realize significant material savings. Furthermore, the films can be deposited on any substrate, have a low balance of systems costs, and can be scaled up easily to mass production. Various experimental techniques to characterize the plasma deposition mechanism are discussed, noting the identification of diverse parameters affecting the quality of the cells produced. Cells having a conversion efficiency around 8% have been fabricated, and a-Si:F:H films are reported which show no performance degradation due to photo-induced changes. Additionally, a photovoltaic-photothermal hybrid has been fabricated, showing a solar total energy conversion efficiency of 55-60%. M.S K.

A83-15511
**THE RESIDUAL VOLTAGE IN FAST ELECTROPHOTOGRAPHY OF A-SIH/X/**
S. ODA, S -I. TERAZONO, and I. SHIMIZU (Tokyo Institute of Technology, Yokohama, Japan) Solar Energy Materials, vol. 8, Nov. 1982, p. 123-128. refs

The space charge distribution in a-SiH(x) photoreceptors is investigated by measurement of the residual voltage in xerographic photodischarge characteristics. The correlation between boron concentrations in the a-SiH(x) photoreceptor and the residual voltage is evaluated. It is found that the space charge is localized within 5000 A of the interface, and that the residual voltage can be eliminated by a proper choice of the boron concentration and of the wavelength of the exciting light. (Author)

A83-15871
**HYDROGENATED A-SI/X/GE/1-X/ - A POTENTIAL SOLAR CELL MATERIAL**
M C. CRETELLA and J. A. GREGORY (Mobil Solar Energy Corp., Waltham, MA) Electrochemical Society, Journal, vol. 129, Dec 1982, p 2850-2855. refs

Attempts to improve the bandgap of a-Si amorphous solar cells were carried out with alloys of a-SiGe(H). The cells were prepared with a plasma glow discharge technique to produce cells with an optical energy gap of 1.0 eV, compared with 1.8 eV for a-Si(H) Changing the ratio of SiH4/GeH4 in the plasma allowed adjustement of the bandgap towards the optimal efficiency in the solar spectrum. Spectral response tests revealed that the a-SiGe(H) cells had shifted their response to longer wavelength regions, although degradations were observed in the open-circuit voltage and fill factor. The addition of Ge to the H-doped amorphous solar cells is concluded to offer the possibility of an improved amorphous solar cell material. M.S.K.

A83-16021
**CHANGES IN PHOTOVOLTAIC AND DARK ELECTRICAL PROPERTIES OF HYDROGENATED AMORPHOUS SILICON DIODES INDUCED BY FORWARD BIAS CARRIER INJECTION**
I. SAKATA and Y. HAYASHI (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Ibaraki, Japan) Electronics Letters, vol. 18, Dec. 9, 1982, p 1075, 1076. Research supported by the Ministry of International Trade and Industry refs

The photovoltaic and dark electrical properties of hydrogenated amorphous silicon diodes were changed by forward bias carrier injection for several hours These changes were similar to photoinduced (PI) changes previously reported, and this result supports previous explanations for PI changes. The differences between these two types of change are also discussed. (Author)

A83-16071
**TRANSPORT MECHANISMS FOR MG/ZN3P2 JUNCTIONS**
F.-C. WANG, A. L. FAHRENBRUCH, and R. H. BUBE (Stanford University, Stanford, CA) Journal of Applied Physics, vol. 53, Dec. 1982, p. 8874-8879. Research supported by the Solar Energy Research Institute. refs

The dominant transport mechanisms for Mg/Zn3P2 junctions are shown to depend on the heat treatment in hydrogen of the Zn3P2 prior to Mg deposition. For heat treatments below 300 C, multistep tunneling via defect centers dominates, whereas for heat treatments between 300 and 500 C, recombination/generation dominates. Correspondence is observed between the imperfections responsible for the junction transport and previously reported imperfections in bulk Zn3P2 crystals. Enhanced tunneling under solar illumination contributes to the low energy conversion efficiency of thin Mg film Mg/Zn3P2 devices. An estimate of the interface recombination velocity for these junctions yields a value of 19,000,000 cm/sec. (Author)

A83-16082
**EFFECT OF HYDROGEN ON THE DEPOSITION RATE FOR PLANAR RF MAGNETRON SPUTTERING OF HYDROGENATED AMORPHOUS SILICON**
J. B. WEBB (National Research Council, Div. of Chemistry, Ottawa, Canada) Journal of Applied Physics, vol. 53, Dec. 1982, p. 9043-9048. refs

A83-16084
**HEAT-TREATMENT STUDIES ON THIN-FILM CDS/CU/X/S SOLAR CELLS**
L. HMURCIK (Clarkson College of Technology, Potsdam, NY) and R A. SERWAY (James Madison University, Harrisonburg, VA) Journal of Applied Physics, vol 53, Dec. 1982, p. 9073-9079 refs
(Contract DE-AC01-79ET-23110)

CdS/CuS polycrystalline solar cells were heat treated in different mixtures of hydrogen and oxygen and examined for the resultant I-V curves. Ten cells were studied, six which were heat treated, then kept in storage for one year Monitoring was also carried out on the short-circuit current density, the open circuit voltage, the fill factor, and the cell efficiency. Several episodes of heat treatment were performed, with measurements carried out after each. It was determined that changes in the copper-sulfide stoichiometry were the cause of changes in the short-circuit current. Monitoring the changes in the short-circuit current during heating in a hydrogen atmosphere permitted optimization of the cell efficiency to within 5% of its theoretical value. The hydrogen-atmosphere heating is noted to increase the CuS layer stoichiometry M.S K.

A83-16086
**EVALUATION OF THERMOPHOTOVOLTAIC CONVERSION EFFICIENCY**
F. DEMICHELIS, E. MINETTI-MEZZETTI, M. AGNELLO, and E. TRESSO (Torino, Politecnico, Turin, Italy) Journal of Applied Physics, vol. 53, Dec. 1982, p. 9098-9104. refs

The efficiency of thermophotovoltaic (TPV) cell is numerically modeled and results from experimentation with a TPV device are reported. The TPV concept involves a cell which absorbs all incident radiation above its band-gap, then reflects all photons outside of the bandgap back to the source as IR radiation, thus augmenting the source heat. The cell was mounted above an electrical resistive heater element which operated behind a quartz lens, a low pressure chamber, and walls coated with gold to enhance reflectivity. Computations were made in terms of the input power, the temperature of the heating element, and the photovoltaic efficiency. The TPV efficiency was found at times to be nearly 30 times the normal solar cell output. Good agreement was obtained between the predictions and the experimental results. M.S.K.

A83-16183
**THE PROPERTIES AND PRODUCTION OF SOLAR CELLS**
R. HILL (Newcastle-upon-Tyne Polytechnic, Newcastle-upon-Tyne, England) Sun at Work in Britain, no. 15, 1982, p. 1-8.

The operational characteristics, techniques of large scale production, the use, and materials for solar cells are reviewed. Attention is given to optimizing cell performance. A maximum theoretical efficiency of 40% is possible, with laboratory specimens thus far attaining 20% levels and mass-produced cells 10-18%. Series and parallel connections of cells in modules to yield specific outputs are considered, together with nominal construction considerations to make the modules resistant to environmental corrosion and the effects of shading from other modules. Ribbon, crystal ingot, and thin film production technologies are discussed, with mention made of the fact that crystalline cells are more expensive, yet have the highest efficiencies, while thin films offer low-cost, mass-production advantages although only 5% efficiencies have been attained with production-scale thin films. Finally, solar cell materials, including Si, CdS, InP, GaAs, and CdTe are investigated, along with prospects for indigenous solar cell production facilities in various countries. M.S.K.

A83-16184
**PHOTOVOLTAIC PROSPECTS IN EUROPE**
M. R. STARR (Sir William Halcrow and Partners, Swindon, Wilts., England) Sun at Work in Britain, no. 15, 1982, p. 9-20. Commission of the European Communities refs
(Contract CEC-ESC-P-049-81-UK)

The economics of solar cells is reviewed with an eye to potential cost reductions in processing, and potential markets are explored. Current solar cell systems costs are noted to be on the road to achieving the U.S. DoE goals of $0.40/kWp by 1990. Continued progress will depend on technical developments in cheaper materials and processes, scaling up production, and the success of sales programs Various consumer and professional markets are outlined, with a prediction that a 12 MWp deman will be reached as a steady state by 1995 Photovoltaic panels may conceivably replace conventional roofing materials, resulting in the projection that, if grid-supplied power continues to inflate in price, then all new European homes would be equipped with photovoltaics by the year 2000 Further, accomplishment of the cost goals could generate a 1 GWp/yr industrial market at the same time. M.S.K.

A83-16562#
**THEORETICAL AND EXPERIMENTAL INVESTIGATION OF HIGH TEMPERATURE INSULATORS SUBJECTED TO INTENSE VISIBLE RADIATION**
L. K. MATTHEWS (New Mexico State University, Las Cruces, NM) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 16 p. refs
(AIAA PAPER 83-0158)

A theoretical and experimental investigation has been performed to determine the radiation and thermal fields in high temperature insulators such as zirconia and alumina-silica. Various material parameters (optical and thermophysical), such as extinction coefficient, backward scattering fraction, thermal diffusivity, and thermal conductivity were estimated using a theoretical model along with experimental data. The techniques of nonlinear parameter estimation (inversion) were formulated to optimally determine the parameters. The experimental investigation was performed in a solar furnace with front surface heat fluxes as high as 600 kW/sq m. Temperatures and transmitted heat fluxes were measured for test samples made of zirconia. The theory of optimal experiment design was used to determine how to best take the data. An extensive statistical error analysis of the parameter estimates was performed, and the resulting parameter estimates should be considered as preliminary. The procedures for using a theoretical model, experimental data and statistical inversion techniques that were developed performed well and showed that considerable information can be obtained from the solar testing of such insulators. (Author)

A83-16946
**HOT-ELECTRON LUMINESCENCE IN AGED ELECTRODEPOSITED CDSE LIQUID-JUNCTION SOLAR CELL**
R. P. SILBERSTEIN and M. TOMKIEWICZ (Brooklyn College, Brooklyn, NY) Applied Physics Letters, vol 42, Jan. 1, 1983, p. 58-60. refs
(Contract XS-9-8312-1)

Raman spectroscopy and scanning Auger electron spectroscopy (AES) have been used to probe the surface of polycrystalline, electrodeposited CdSe photoelectrodes which have been aged in a polysulfide electrolyte under illumination and in darkness. Characteristic 'hot-electron' luminescence has been observed at multiples of omega (LO) (CdS) = 305/cm in the light-aged electrode, indicating that a surface layer of CdS has been formed. AES profiling shows that extensive substitution of S for Se has occurred, in the light-aged electrode alone, to a depth of approximately 600 A. Measurements at 300 K suggest that Raman scattering can be a useful, in situ, contactless, nondestructive probe of CdS formation. (Author)

A83-17150
**DESIGN OF ELECTRONIC OPTIMIZER FOR SOLAR ELECTRIC DRIVE SYSTEM**
E-H. T. EL-SHIRBEENY (University of Technology, Baghdad, Iraq) International Journal of Energy Research, vol 6, Oct.-Dec 1982, p. 367-376. refs

The design for an electronic optimizer connected to the photovoltaic converter circuit for a solar electric powered pumping station is presented. The generator assembly considered is a series of solar cell modules, and is equipped with a low-pass filter to screen out radio frequency and higher harmonics which can degrade system performance. Optimization of the voltage output is shown to depend on the presence of a control device and a passive storage subsystem at the load terminals. The electronic optimizer described comprises an IC chip for incorporating internal power supplies with reference voltages, a sawtooth generator, a comparator, a power transistor, and operation from 3-18 V dc. A block diagram is furnished of the optimizer circuitry. The optimizer assures optimum voltage under all insolation conditions, relying on a servo chopper to maintain highest efficiencies. M S K.

A83-17347
**DEVELOPMENT OF THE SPHERICAL SILICON SOLAR CELL**
W. R. MCKEE (Texas Instruments Central Research Laboratories, Dallas, TX) (Institute of Electrical and Electronics Engineers, Electronic Components Conference, 32nd, San Diego, CA, May 10-12, 1982.) IEEE Transactions on Components, Hybrids, and Manufacturing Technology, vol CHMT-5, Dec. 1982, p. 336-341. refs
(Contract DE-AC01-79ER-100000)

A unique photovoltaic/electrochemical solar energy conversion/storage system utilizing silicon spheres as the individual photovoltaic elements is being developed at Texas Instruments. A new technology has been developed to produce high-purity single-crystal silicon spheres at high throughput rates. The spherical geometry offers several advantages including high crystal growth rate, simplified in-process material flow, and excellent silicon material utilization. The silicon sphere production process is discussed and the device efficiency status and goals are presented. (Author)

A83-17493
**ENVIRONMENTALLY INDUCED DISCHARGES IN A SOLAR ARRAY**
D. B. SNYDER (Case Western Reserve University, Cleveland, OH) (IEEE, DOD, NASA, and DOE, Annual Conference on Nuclear and Space Radiation Effects, 19th, Las Vegas, NV, July 20-22, 1982.) IEEE Transactions on Nuclear Science, vol. NS-29, Dec. 1982, p. 1607-1609. refs

The charging and discharging characteristics of an electrically isolated solar array segment are studied. The details of the test apparatus are described, the surface voltage profiles as a function of the beam angle of incidence are discussed, and the discharge transient characteristics are presented. The results from the biased array are given to provide a comparison with the floating array results. A relatively slow, repetitive discharge is seen at low electron densities which releases about 10% of the charge on the array. Single faster discharges are seen which release currents on the order of microamps for a few tenths of a second. Minor discharges emit about 4% of the charge, while major discharges emit about 90%. The slow and fast minor discharges appear to be smaller than the discharges induced by biasing the interconnects negative with respect to the cover slides. C D.

A83-17766
**THIN FILM POLYCRYSTALLINE SI P-N JUNCTION SOLAR CELLS WITH PREFERENTIAL DOPING**
S. ELNAHWY and N. ADEEB (Cairo, University, Giza, Egypt) Solid-State Electronics, vol. 25, Nov. 1982, p. 1111-1117. refs

A model has been introduced for a polycrystalline thin film silicon p-n junction solar cell with preferential doping along the grain boundaries. Detailed numerical calculations have been done for the effect of doping depths along the grain boundaries, for different grain sizes, on the performance of the cell under AM1 conditions. The results indicate that preferential doping of grain boundaries leads to significant improvement of the cell performance. (Author)

A83-17767
**THEORY OF OPEN CIRCUIT PHOTO-VOLTAGE IN DEGENERATE ABRUPT P-N JUNCTIONS**
D. V. KUMAR and S. K. SHARMA (Indian Institute of Technology, New Delhi, India) Solid-State Electronics, vol. 25, Dec 1982, p. 1161-1164 Research supported by the Indian National Science Academy refs

A83-17770
**ON THE OPEN-CIRCUIT VOLTAGE OF A SCHOTTKY-BARRIER MIS SOLAR CELL**
A N DAW, A. K DATTA, and M. C. ASH (Indian Institute of Radio Physics and Electronics, Calcutta, India) Solid-State Electronics, vol 25, Dec. 1982, p. 1205, 1206. refs

A83-17801
**DESIGN OF A 13% EFFICIENT N-GAAS/1-X/P/X/ SEMICONDUCTOR-LIQUID JUNCTION SOLAR CELL**
C. M. GRONET and N. S. LEWIS (Stanford University, Stanford, CA) Nature, vol. 300, Dec. 23, 1982, p. 733-735. refs

The design of the most efficient nonaqueous semiconductor-liquid junction solar cell studied to date is reported. Ternary semiconductor electrodes made from solid solutions of GaP and GaAs were utilized. Changes in the open voltage circuit voltage were studied for these materials as a function of solution potential with a variety of redox reagents, and it was found that photoanodes consisting of these materials are capable of simultaneously yielding high open circuit voltages and favorable wavelength response to the solar spectrum. Thirteen percent efficiencies were obtained with no deliberate attempts to optimize fully donor densities, reflectivity losses, and surface treatments. C.D.

A83-18139
**A PARAMETRIC ANALYSIS OF THE PERFORMANCES OF A LINEAR COLLECTORS' NETWORK OF A SOLAR POWER PLANT**
C. BELLECCI, A. BONANNO, M. CAMARCA, M. CONTI, L. LA ROTONDA, G. PICCINI, and R. VISENTIN (Calabria, Universita, Rende, Italy) Nuovo Cimento C, Serie 1, vol. 5C, May-June, 1982, p. 359-373. Research supported by the Consiglio Nazionale delle Ricerche. refs

A83-18451
**HEAT TRANSFER AND FLUID MECHANICS INSTITUTE, MEETING, 28TH, CALIFORNIA STATE UNIVERSITY, SACRAMENTO, CA, JUNE 28, 29, 1982, PROCEEDINGS**
F. M. REARDON, (ED.) (California State University, Sacramento, CA) Meeting sponsored by the American Society of Mechanical Engineers and California State University. Sacramento, CA, CSUS University Publications, 1982. 219 p.

Various topics in fluid mechanics, heat transfer, and solar and wind energy conversion were discussed. Consideration was given to numerical modeling of the mass flow, pressure, and temperature in air-medium flat plate solar collectors. Computer simulations of three-dimensional confined vortex flow were reported, as was a study of the priming characteristics of monogroove heat pipes in the zero-g environment of a Space Operations Center. The unsteady heating of a solid body by a hot gaseous jet was explored. A northwest California wind energy survey for wind farm sites was described. Finally, an analytic treatment of the benefits of using dynamic inducer tip vanes on wind turbine rotors was presented. D.H.K.

A83-18452
**AN ANALYTICAL INVESTIGATION OF MASS FLOW, PRESSURE AND TEMPERATURE IN A FLAT-PLATE SOLAR COLLECTOR**
H. T. PHAN (California Department of Transportation, Sacramento, CA) and N. D. THINH (California State University, Sacramento, CA) In: Heat Transfer and Fluid Mechanics Institute, Meeting, 28th, Sacramento, CA, June 28, 29, 1982, Proceedings. Sacramento, CA, CSUS University Publications, 1982, p. 17-33. refs

A study of mass flow, pressure and temperature interactions in a flatplate solar collector is presented with the assumption that the working fluid is compressible with friction and no phase change. The theoretical analysis is based on compressible flow and heat transfer fundamentals together with the working equations which ary widely used in solar energy applications. The results of this study show that: (1) the fluid temperature approaches the tube wall temperature asymptotically as 1/D increases for fixed inlet and insolation conditions, (2) the fluid pressure decreases as the ratio of tube length to tube diameter (1/D) increases, (3) the mass flow rate increases as 1/D increases. (Author)

A83-18497#
**INTERACTION OF ELECTROMAGNETIC RADIATION AND MICROSTRUCTURAL MATERIALS WITH REGARD TO THE PRODUCTION OF SPECTRAL-SELECTIVE SOLAR ABSORBERS [WECHSELWIRKUNG VON ELEKTROMAGNETISCHER STRAHLUNG UND MIKROSTRUKTURIERTER MATERIE IM HINBLICK AUF DIE ERZEUGUNG SPEKTRALSELEKTIVER SOLARABSORBER]**
W. SCHERBER Stuttgart, Universitaet, Fakultaet Elektrotechnik, Dr.-Ing Dissertation, 1981. 145 p. In German. refs

New theoretical and technological solutions for solar-selective absorption layers are presented. The theory of optical structural filters is discussed, including scattering from individual particles, and systems of large and very small particles. For the first of these, the calculation of effective factors and anisotropy factors, as well as the results of Mie theory, are dealt with. For very small particle systems, the role of effective refractive index and of Lorentz-Lorenz theory are covered. For larger-particle systems, two- and six-ray theories, anisotropic directional factors, and inhomogeneous packing density are addressed. The theory is experimentally tested for the construction of filter structures, including subtractive and electrochemical procedures, vacuum and gas-phase separation, and thermal conversion. Results are also found for individual components such as needle structures, powder structures, and macrostructures. The application of the theory to the optimization of pigment layers and of needle, powder, and pore structures is discussed C.D.

A83-18554
**SOLAR ENERGY STORAGE BY THE REVERSIBLE REACTION - N2O4 YIELDS 2NO2 - THEORETICAL AND EXPERIMENTAL RESULTS**
V. RAGAINI (Sassari, Universita, Sassari, Italy) Solar Energy, vol. 29, no. 6, 1982, p. 535-540. refs

The suitability of the reversible reaction between N2O4 and 2NO2 for short term solar energy storage applications were examined theoretically and experimentally. N2O4 dissociates completely at 140 C, while NO2 seldom dissociates below 150 C. The heat storage capacity of the reaction 2NO2 yields N2O4 was calculated for the temperature intervals between 0-500 C, showing that a maximum of 195.7 kcal/l is available with liquified 2NO2, compared to 100 kcal/l with water. Nitrogen dioxide was tested in the gas phase in a solar collector. The results indicate a heat storage capacity from 3 to 1.7 times that of water, and its use for a domestic hot water energy source is described Toxicity problems with 2nO2 and the formation of nitric acid are suggested to be solvable by use of nitrogen dioxide in anhydrous form and in stainless steel apparatus. M.S.K.

A83-18557
**UNIVERSAL GRAPH FOR OPTIMAL DIMENSIONS OF SOLAR COLLECTOR PLATE**
M. KOVARIK (Commonwealth Scientific and Industrial Research Organization, Div. of Mechanical Engineering, Highett, Victoria, Australia) Solar Energy, vol. 29, no. 6, 1982, p. 573, 574.

A83-18558
**A NEW EVACUATED CPC COLLECTOR TUBE**
J. J. O'GALLAGHER, K. SNAIL, R. WINSTON (Chicago, University, Chicago, IL), C. PEEK (GTE Research Laboratories, Waltham, MA), and J. D. GARRISON (San Diego State University, San Diego, CA) Solar Energy, vol. 29, no. 6, 1982, p. 575-577. refs
(Contract DE-AC02-80ER-10558)

Design features, performance goals, and test results with components of a complete panel of a new evacuated compound parabolic concentrator (CPC) solar heat collector are presented Performance gains over previous designs were projected to accrue from placing the reflector surface in a vacuum to eliminate surface degradation, and the use of a glass cover eliminated the need for an external glazing, a step that improves the optical efficiency. Isolation of the glass vacuum enclosure from the metal absorber ensures that thermally induced breakage of the vacuum seal does not occur. No tilt adjustments are included in the module design, which features a fixed 35 deg acceptance angle. The mirrored surface provides a 1.64 power concentration. A prototype installation yielded 40% efficiencies over an ambient-300 C range The CPC is intended for applications in building heat and cooling, industrial process heat, and low temperature electricity generation M.S.K.

A83-18559
**PROJECTED TEMPERATURE DEPENDENCE OF QUANTUM YIELDS FOR PHOTOREACTIONS INVOLVING ENERGY OR ELECTRON TRANSFER**
G. JONES, II and R. J. BUTLER (Boston University, Boston, MA) Solar Energy, vol. 29, no. 6, 1982, p. 579-587. Research supported by the U.S. Department of Energy. refs

Parameters are defined for developing a model for the increase in reaction rates in a photosensitive energy generation system due to the addition of heat to the system. Microscopic rate constants taken from published data are employed to calculate quantum yields and the rates of bimolecular quenching. The resultant data are used to establish the sensitivity of the energy yields and quenching rates to temperature and to the standard free energy change for electron or energy transfer. Account is also made for reorganizational energy, i.e., a geometry change or distortion. Examples were worked out for two dyes in the temperature range 273-423 K with a quencher concentration of 0.1 M. The free energy change and the decay parameters for each dye are provided, noting the use of dyes with ambient temperature lifetimes of 1-10 microsec. Easily realizable

temperature raises were found to produce acceptable quantum efficiencies involving an endothermic electron or energy transfer step. M.S.K.

**A83-18563**
**STABILITY OF SNO2 THIN FILMS USED FOR PHOTOVOLTAIC DEVICES**
G. N. ADVANI and A. G. JORDAN (Carnegie-Mellon University, Pittsburgh, PA) Solar Energy, vol. 30, no. 1, 1983, p. 71-73. Research supported by the Mine Safety Appliances Co. refs (Contract EE-77-S-02-4346)

Conducting films of SnO2, prepared by RF Sputtering, were studied for their stability following a heat treatment at 200 C in air. Auger Spectroscopy was used to analyze the surface and bulk compositions both before and after the tests. The results so obtained, indicated that the main changes in the film took place in the first 400 A. This was viewed as seriously limiting the efficiency of solar cells employing transparent windows on the front surface. (Author)

**A83-18564**
**TRANSMITTANCE OF REFLECTED DIFFUSE RADIATION**
H. F. CHIAM (Commonwealth Scientific and Industrial Research Organization, Div. of Energy Technology, Highett, Victoria, Australia) Solar Energy, vol. 30, no. 1, 1983, p. 75-78. Research supported by the National Energy Research, Development and Demonstration Program refs

A correlation is developed which allows the transmittance of reflected diffuse radiation from a planar reflector to be determined. An initial evaluation of the geometric cover-to-reflector configuration, or view factor, is involved in the use of the correlation. The evaluation of the reflected irradiance on the cover requires the value of the configuration factor. The practical implications of these findings are also discussed. N.B.

**A83-18565**
**STUDIES ON RADIATION INTENSITY DISTRIBUTION IN THE FOCUS OF COMPOUND PARABOLIC CONCENTRATORS**
I C. MACEDO (Campinas, Universidade Estadual, Campinas, Sao Paulo, Brazil) and C. L. FARIA ALVES (Instituto Tecnologico de Aeronautica, Sao Paulo, Brazil) Solar Energy, vol. 30, no. 1, 1983, p. 79-83. Research supported by the Fundacao de Amparo a Pesquisa do Estado de Sao Paulo. refs

**A83-18825**
**A SIMPLE PARAMETER MEASUREMENT SYSTEM FOR SOLAR CELLS**
A. NEDUNGADI and R. SHARAN (Indian Institute of Technology, Kanpur, India) IEEE Transactions on Instrumentation and Measurement, vol. IM-31, Sept. 1982, p. 206, 207.

A simple measurement system which quickly obtains the relevant parameters V(oc, I(sc), P(max), and V(max) of a solar cell under illumination has been described. The system has reasonably good accuracy, and should save considerable testing time and effort in applications where a large number of solar cells have to be tested, characterized, or matched. (Author)

**A83-19148**
**OPERATIONAL CONSIDERATIONS ON THE MOON-DAY PROJECT**
M. SALMON Acta Astronautica, vol. 9, Aug. 1982, p. 515-523. refs

The potentials for illuminating any particular locale on the earth using expansive mirror arrays placed on the moon are explored, together with the design of the mirror systems. Attention is given to the astronomical parameters governing the implementation of the concept. It is found that a 10 million sq km night time area can be lighted at most 1/2 the time. A lunar mirrored area 10 sq km in area is required to produce one-moon illumination (1/1,000,000 sun). However, 10 moons are necessary for agriculture, 100 for street lighting, and 1000 for reading. It is assumed that the mirrors would be in a central lunar location. Considerations of changing illumination angles indicate that only one region at a time on earth could be illuminated, with changes of target areas possibly occurring on a daily or yearly basis D.H.K.

**A83-19194**
**AXISYMMETRIC REFLECTORS OF THE STEPPED SPHERICAL TYPE**
B. AUTHIER (CNRS, Laboratoire d'Astronomie Spatiale, Marseille, France) Journal of Optics, vol. 13, Sept -Oct. 1982, p. 309-315 refs

A family of rotationally symmetrical segmented reflectors, fully corrected for spherical aberration, is defined. The discontinuous meridian curve of each reflector consists of elementary mirrors parallel to the tangent of an axisymmetric curve (called the generating curve) at the point located at the same distance from the common axis. The third order aberration patterns of reflectors for which the generating curve is a circular segment are studied. This leads to the definition of easily built stepped spherical collectors of large aperture and narrow field angle, which can be used as high concentration solar collectors. (Author)

**A83-19236#**
**PROSPECTS FOR THE CONSTRUCTION OF SOLAR FURNACES FOR INDUSTRY [PERSPECTIVES SUR LA REALISATION DE FOURS SOLAIRES A VOCATION INDUSTRIELLE]**
CH. H. LA BLANCHETAIS (CNRS, Groupe des Laboratoires de Bellevue, Meudon, Hauts-de-Seine, France) Entropie, vol. 18, no. 107-108, 1982, p. 28-61. In French. refs

The various techniques and prototype installations employed to absorb and concentrate solar energy for use in applications requiring 100-4000 C temperatures are explored. Mention is made of the Pericles heliostat field and the THEK distributed parabolic concentrator installations, and attention is focused on viable concepts useful for industrial purposes. The Odeillo solar furnace provided design guidelines and requirements for industrial usage. It was found that the reliability of the furnace depends on the annual insolation, that the solar furnaces must be designed to meet specific thermal goals, that simplification and optimization are needed for the orientation and focusing mechanisms, and that solar furnaces are ideally suited for developing nations which experience high levels of insolation. A stepped paraboloid is described for improving the efficiency of a heliostat system, while still employing plane parallel mirrors. M.S.K.

**A83-19238#**
**A PROJECT FOR EXPLOITATION OF A NEW FORM OF SOLAR ENERGY: THE WIND CHILL. I - THE IMPORTANCE TO THE ENERGY FIELD. II - APPLICATION FOR BUILDING HEAT AND ELECTRICITY PRODUCTION [PROJET D'EXPLOITATION D'UNE NOUVELLE FORME DE L'ENERGIE SOLAIRE: LA 'FROIDEUR DU VENT'. I - IMPORTANCE DU GISEMENT D'ENERGIE. II APPLICATION AU CHAUFFAGE DES BATIMENTS ET A LA PRODUCTION D'ELECTRICITE]**
P. LE GOFF (CNRS, Laboratoire des Sciences du Genie Chimique; Lorraine, Institut National Polytechnique, Nancy, France) Entropie, vol. 18, no. 107-108, 1982, p. 122-140. In French. refs

Calculations of the temperature, humidity, pressure, and velocity of the wind at different locations are provided to demonstrate that energy characteristics of the wind other than the mechanical pressure exerted by the wind on obstacles are significant. A system is described, based on the heat pump principle, which takes advantage of the thermal inertia of the wind, known to remain around freezing even in Siberian winters. An analysis of the energy available for heat transfer in a site in France demonstrates that the dryness, warmth, or chill of a cubic meter of air contains, continuously, 100-1000 times the kinetic energy of moving air. In excess of one kilowatt/sq m is available for extraction by heat pumps based on designs for ocean thermal energy conversion. An electric generating system is described which would yield 10-50 times the mechanical power of a windmill using the same collector area. Finally, a wall heat exchanger for a house is presented which would gain heat energy proportional to the seventy of the winter wind. M.S.K.

**A83-19259**
**PHOTOVOLTAIC PROPERTIES OF CADMIUM SULFIDE/TRIVALENT-METAL PHTHALOCYANINE HETEROJUNCTION DEVICES**
A.-M. HOR, R. O. LOUTFY, and C.-K. HSIAO (Xerox Research Center of Canada, Mississauga, Ontario, Canada) Applied Physics Letters, vol. 42, Jan. 15, 1983, p. 165-167. Research supported by the National Research Council of Canada. refs

Thin-film photovoltaic devices consisting of a CdS/trivalent-metal phthalocyanine heterojunction have been prepared. The devices are fabricated by first electrodepositing a thin film of CdS onto a transparent conducting indium-tin-oxide substrate and then depositing phthalocyanine and gold layers sequentially in a vacuum coater. The trivalent-metal phthalocyanines used are chloroaluminum chlorophthalocyanine, chloroaluminum phthalocyanine, and chloroindium phthalocyanine. Under an AM2 illumination of 75 mW/sq cm, these heterojunction devices produce an open-circuit voltage of 0.70 V and short-circuit current of 0.8 mA/sq cm. The conversion efficiency is about 0.2 percent, which represents one of the highest values reported for phthalocyanine photovoltaic devices at high light intensity.
(Author)

**N83-10286#** Kajima Inst. of Construction Technology, Tokyo (Japan).
***THE SOLAR ASSISTED AIR-SOURCE HEAT PUMP SYSTEM, PART 1***
T. HINO Nov. 1980 82 p refs
(PB82-218439; KICT-35) Avail: NTIS HC A05/MF A01 CSCL 13A

A new heat pump heating and air conditioning system was proposed and tested. It features the effective utilization of climatic conditions as its heat sources and sinks, to improve the thermodynamic efficiencies. Reduced electricity consumption, utility load leveling and the least environmental pollutions are expected. The outdoor unit of this heat pump is composed of aluminum panels that are painted black to enhance the radiative heat exchange and fixed almost perpendicularly to improve the natural convective heat transfer with air. The working fluid is halocarbon and commonly used in the heat transfer circuits and the refrigeration cycle. In the heating cycle, the liquid refrigerant evaporates in the passages of the panel. When insolation to the panels is sufficient to meet the heat pump evaporator capacity, the panel temperature will be almost the same as the outdoor air temperature. Thus little convective heat loss to the surrounding air occurs. As the insolation decreases the panel temperature falls several degrees below the outdoor air to absorb heat out of the air until the equilibrium condition is reached. GRA

**N83-10297#** National Bureau of Standards, Washington, D.C. Center for Building Technology.
**ANALYSIS OF THERMAL COMFORT IN A PASSIVE SOLAR HEATED RESIDENCE**
S. LIU Nov. 1981 36 p refs Sponsored by DOE
(PB82-180142; NBSIR-81-2393) Avail: NTIS HC A03/MF A01 CSCL 13A

The thermal comfort conditions in a passive solar heated residence of the popular Trombe Wall configuration were investigated. The indoor thermal environment of an actual passive solar residence, using the typical meteorological year (TMY) weather data tape as input as three locations of different climatic conditions was simulated. The relevant thermal comfort parameters such as the space air temperature, mean radiant temperatures, operative temperatures, radiant temperature asymmetry, and temperature drifts of the occupied zone, were computed for a prime heating month, a transition month and a prime cooling month of a typical weather year at the three locations. It is found that for the specific passive solar residence analyzed, the upper boundary of the comfort envelope can be exceeded (overheating) during a typical clear day in the transition month of April unless a change of clothing to summer wear is made during the daytime high solar radiation house. The upper boundary will be exceeded during a typical clear day in the prime cooling month of August for a person in typical summer clothing at all three locations unless the average air movement in the occupied zone is increased above the level of natural circulation, or the thermostat setting is reduced to a lower level, or both. GRA

**N83-10494*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHOD FOR DEPOSITING AN OXIDE COATING Patent**
G. E. MCDONALD, inventor (to NASA) 21 Sep. 1982 7 p Filed 23 Mar. 1981 Supersedes N81-24230 (19 - 15, p 2033)
(NASA-CASE-LEW-13131-1; US-PATENT-4,350,574; US-PATENT-APPL-SN-246772; US-PATENT-CLASS-204-56R)
Avail: US Patent and Trademark Office CSCL 10A

A metal oxide coating is plated onto a metal substrate at the cathode from an acid solution which contains an oxidizing agent. The process is particularly useful for producing solar panels. Conventional plating at the cathode avoids the presence of oxidizing agents. Coatings made in accordance with the invention are stable both at high temperatures and while under the influence of high photon flux in the visible range.
Official Gazette of the U.S. Patent and Trademark Office

**N83-10500#** Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
**AN EXPERIMENTAL INVESTIGATION OF CONVECTIVE LOSSES FROM SOLAR RECEIVERS Final Report**
A. M. CLAUSING Aug. 1981 27 p refs Sponsored by DOE
(UILU-ENG-81-4003; ME-TN-81-9180-3) Avail: NTIS HC A03/MF A01

Convective energy loss from the receiver of a 10 mw solar thermal electric plant was determined. N.W.

**N83-10505*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**FLAT PLATE SOLAR ARRAY PROJECT: PROCEEDINGS OF THE 20TH PROJECT INTEGRATION MEETING Progress Report, Nov. 1981 - Apr. 1982**
R. R. MCDONALD Apr. 1982 543 p Meeting held at Pasadena, Calif., 21-22 Apr. 1981
(Contract NAS7-100; DE-AI01-76ET-20356)
(NASA-CR-169370; DOE/JPL-1012-71; JPL-PUB-82-48; JPL-5101-209; NAS 1.26:169370; PR-20) Avail: NTIS HC A23/MF A01 CSCL 10B

Progress made by the Flat-Plate Solar Array Project during the period November 1981 to April 1982 is reported. Project analysis and integration, technology research in silicon material, large-area silicon sheet and environmental isolation, cell and module formation, engineering sciences, and module performance and failure analysis are covered.

**N83-10507*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**FSAS FUTURE ROLE**
W. T. CALLAGHAN *In its* Flat Plat Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 61-65 Apr. 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

The latest thinking about how the Flat-Plate Solar Array Project (FSA), will redirect activities away from recent product-oriented technology development efforts and toward longer-term research on technical problems that could limit future large-scale use of photovoltaics is addressed. With the emphasis on research, the Project is now organizing a series of workshops addressing the key basic technological questions by specific topic. Intervals between Project Integration Meetings are being extended because there are fewer contracts within ESA and because work under those contracts has been attenuated. J.M.S.

**N83-10508*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**UNION CARBIDE CORP. POLYSILICON STATUS AND PLANS**
M H. LEIPOLD *In its* Flat Plate Solar Array Proj.. Proc. of the 20th Proj. Integration Meeting p 67-69 Apr 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

The status of polysilicon activities is summarized highlighted by moving the silane portion of the experimental process system development unit (EPSDU) to Washougal, Washington. The completion and operation of the silane EPSDU, is discussed along with research on the silane-to-silicon deposition process. Progress on the dichlorosilane process is also reported J.M.S.

**N83-10509*#** Kayex Corp , Rochester, N. Y.
**ADVANCED CZOHCRALSKI INGOT GROWTH**
R. L. LANE *In* JPL Flat Plate Solar Array Proj : Proc. of the 20th Proj. Integration Meeting p 71-98 Apr. 1982
Avail NTIS HC A23/MF A01 CSCL 10A

A summary of advanced Cz ingot-growth activities is presented. Five ingots (totalling 150 kg) were grown from one crucible by use of chunk silicon replenishment between ingot pulls. The cost of the ingot growth was reduced from $80/kg (conventional Cz growth) to $20/kg. Further improvements can be made by achieving a better understanding of crystalline silicon growth and the influence on growth of contaminants from the atmosphere and/or the crucible. This should lead to a higher percentage of monocrystalline growth and possible increased growth rates. J.M S.

**N83-10510*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena
**BLOCK 5 MODULE DESIGN SUMMARY**
L. D RUNKLE *In its* Flat Plate Solar Array Proj.: Proc. of the 20th Proj Integration Meeting p 99-103 Apr. 1982
Avail NTIS HC A23/MF A01 CSCL 10A

The Flat Plate Solar Array Block 5 Module design efforts of six manufacturers are summarized. Residential designs and module designs for intermediate-load applications are described. It is planned that a few prototype modules of each design will be fabricated. The modules incorporate advanced concepts, are larger than earlier ones and have high power output. J.M.S.

**N83-10511*#** Sandia Labs., Albuquerque, N. Mex.
**CENTRAL-STATION APPLICATIONS: SYSTEM AND SUBSYSTEM RESEARCH ACTIVITIES**
G J JONES *In* JPL Flat Plate Solar Array Proj.: Proc of the 20th Proj. Integration Meeting p 105-111 Apr. 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

The results of a number of photovoltaic central power-station studies are summarized. Analysis based upon vendor quotes and construction contractor bids indicate that $50/m2 for area related costs for flat-plate arrays is achievable. Electrical design tradeoffs for multimegawatt systems are considered. The values of photovoltaic central-station plants for various regions are determined from an energy scenario effects study J.M.S.

**N83-10512*#** Aerospace Corp , El Segundo, Calif.
**PV LARGE SYSTEMS PROJECT**
S. L. LEONARD *In* JPL Flat Plate Solar Array Proj.· Proc. of the 20th Proj. Integration Meeting p 113-122 Apr. 1982
Avail· NTIS HC A23/MF A01 CSCL 10A

Near term photovoltaic central-station markets are analyzed. Cost effectiveness of photovoltaic plants is determined in terms of reduction of oil consumption The breakeven photovoltaic system cost vs oil-steam power generation is given. The value of photovoltaic power plants in Southern California and in Los Angelos is given in terms of fuel savings and capacity value The potential value of third party financing, facilitated by Federal and state tax incentives is analyzed J.M.S

**N83-10513*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena
**SACREMENTO MUNICIPAL UTILITY DISTRICT 100-MW SUB E PHOTOVOLTAIC PLANT**
R. V POWELL *In its* Flat Plate Solar Array Proj.: Proc. of the 20th Proj Integration Meeting p 123-124 Apr. 1982
Avail. NTIS HC A23/MF A01 CSCL 10B

A status report on plans for the Sacramento Municipal Utility District (SMUD) 1-MW photovoltaic power plant is presented. DOE, the California Energy Commission, and SMUD will fund the project cooperatively Emphasis is placed on the details of the government contract/cooperation agreement

**N83-10514*#** Spectrolab, Inc., Sylmar, Calif
**PV HISTORY: LESSONS FOR THE FUTURE**
E L. RALPH *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 131-135 Apr. 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

A history of terrestrial photovoltaics is presented indicating that the photovoltaic poential was well perceived and a good technology developent plan was formulated and implemented. Major accomplishments of the technology plan are highlighted. Research objectives and research needs for the future are outlined. J.M S.

**N83-10515*#** Lincoln Lab., Mass. Inst of Tech., Lexington.
**ROOFTOP APPLICATIONS**
E. KERN *In* JPL Flat Plate Solar Array Proj · Proc. of the 20th Proj. Integration Meeting p 147-150 Apr. 1982
Avail. NTIS HC A23/MF A01 CSCL 10A

Research on residential photovoltaic power systems based upon the experience of MIT-LL in implementing the DOE Residential Demonstration Project, especially the Northeast Residential Experiment Station (NE RES) is discussed. There is an immediate need for improved power-conditioner operational and reliability capabilities. Continuing evaluation of photovoltaic power systems is required to verify long-term performance, reliability, and utility interface effects. In the long term, the price of photovoltaic power systems must decrease, especially of modules. J.M.S.

**N83-10516*#** Mobil Tyco Solar Energy Corp., Waltham, Mass.
**PHOTOVOLTAIC RESEARCH NEEDS INDUSTRY PERSPECTIVE**
K. V. RAVI *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 155-160 Apr. 1982
Avail· NTIS HC A23/MF A01 CSCL 10A

An industries perspective of photovoltaic research needs is presented. Objectives and features of industry needs are discussed for the materials, devices, processes, and reliability research categories. J.M.S

**N83-10517*#** Pennsylvania Univ., Philadelphia
**RESEARCH POSSIBILITIES? NO! NEEDS FOR RESEARCH TO MAKE PV SOLAR ENERGY UTILIZATION BROADLY COMPETITIVE**
M. WOLF *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 161-169 Apr. 1982
Avail· NTIS HC A23/MF A01 CSCL 10A

The historical progression of efficiency improvements, cost reductions, and performance improvements in modules and photovoltaic systems are described. The potential for future improvements in photovoltaic device efficiencies and cost reductions continues as device concepts, designs, processes, and automated production compabilities mature. Additional step-function improvements can be made as today's simpler devices are replaced by more sophicated devices J.M S.

**N83-10518*#** Midwest Research Inst., Golden, Colo.
**EVALUATION OF ADVANCED R AND D TOPICS IN PHOTOVOLTAICS**
T. SUREK *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj Integration Meeting p 171-178 Apr. 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

An evaluation of advanced research and development topics in photovoltaic that is summarized. The intent was to develop priorities in a list of advanced research and development activities. Thirty-five activities in 10 major categories were evaluated by their contributions to basic scientific advances, potential impact on further technology development by private industry, and priorities for federal advanced research and development funding. J.M.S.

**N83-10519*#** Union Carbide Corp., Tonawanda, N.Y
**FLAT-PLATE COLLECTOR RESEARCH AREA: SILICON MATERIAL TASK**
R. LUTWACK *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 179-226 Apr. 1982 Prepared in cooperation with Solarelectronics, Inc., Hemlock Semiconductor Corp., Mich., and JPL
Avail: NTIS HC A23/MF A01 CSCL 10A

Silane decomposition in a fluidized-bed reactor (FBR) process development unit (PDU) to make semiconductor-grade Si is reviewed. The PDU was modified by installation of a new heating system to provide the required temperature profile and better control, and testing was resumed. A process for making trichlorosilane by the hydrochlorination of metallurgical-grade Si and silicon tetrachloride is reported. Fabrication and installation of the test system employing a new 2-in.-dia reactor was completed. A process that converts trichlorosilane to dichlorosilane (DCS), which is reduced by hydrogen to make Si by a chemical vapor deposition step in a Siemens-type reactor is described. Testing of the DCS PDU integraed with Si deposition reactors continued. Experiments in a 2-in.-dia reactor to define the operating window and to investigate the Si deposition kinetics were completed.
Author

**N83-10520*#** Westinghouse Electric Corp., Pittsburgh, Pa.
**LARGE-AREA SILICON SHEET TASK**
A. D. MORRISON *In* JPL Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 227-320 Apr. 1982 Prepared in cooperation with Mobil Tyco Solar Energy Corp., Semix, Inc., Cornell Univ., Ithaca, NY, Illinois Univ., Chicago and Applied Solar Energy Corp.
Avail: NTIS HC A23/MF A01 CSCL 10A

A set of computer models was used to define a growth system configuration that was then built and used to grow web with lower thermally generated stress. Aspects of research in the edge-defined film-fed growth (EFG) method of making Si ribbon are reported. A technique was developed to determine base resistivity and carrier lifetime in semicrystalline wafers. Automated growth of 150 kg of 15 cm-dia ingot material per crucible is reviewed. Scanning transmisson electron microscopy (STEM) and microprobe investigations of processed EFG ribbon are reported. The chemical composition of the large precipitates was studied. The structural arrangement and the electrical activity of distentions or close to the central twin plane in processed material were studied. The electrical and structural properties of grain boundaries in silicon are discussed. Temperature-dependence measurements of zero-bias conductance, a photoconductivity technique, and deep-level transient spectroscopy (DLTS) were developed. A grooving and staining technique, secondary ion mass spectroscopy, and EBIC measurements in scanning electron microscopy were used to study enhanced diffusion of phosphorus at grain boundaries in polycrystaline silicon. The fundamental mechanisms of abrasion and wear and the deformation of Si by a diamond in various fluid environments are described. The efficiency of solar cells made from EFG ribbon and Semix Inc. material is reported. Author

**N83-10521*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ENVIRONMENTAL ISOLATION TASK**
C. D. COULBERT *In its* Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 321-361 Apr. 1982 Prepared in cooperation with Springborn Labs., Inc. and Spectrolab, Inc., Sylmar, Calif.
Avail: NTIS HC A23/MF A01 CSCL 10A

The failure-analysis process was organized into a more specific set of long-term degradation steps so that material property change can be differentiated from module damage and module failure Increasing module performance and life are discussed. A polymeric aging computer model is discussed. Early detection of polymer surface reactions due to aging is reported. Author

**N83-10522*#** Ross (Bernd) Associates, San Diego, Calif
**CELL AND MODULE FORMATION RESEARCH AREA**
D. B. BICKLER *In* JPL Flat Plate Solar Array Proj.. Proc. of the 20th Proj. Integration Meeting p 363-426 Apr. 1982 Prepared in cooperation with JPL, Spectrolab, Inc., Sylmar, Calif., Photowatt International, Inc., Spire Corp., Solarex Corp., Westinghouse Electric Corp., Pittsburgh, and Pennsylvania Univ., Philadelphia
Avail: NTIS HC A23/MF A01 CSCL 10A

Metallization is discussed. The influence of hydrogen on the firing of base-metal pastes in reducing atmospheres is reported. A method for optimization of metallization patterns is presented. A process sequence involving an AR coating and thick-film metallization system capable of penetrating the AR coating during firing is reported. Design and construction of the NMA implantation machine is reported. Implanted back-surface fields and NMA primary (front) junctions are discussed. The use of glass beads, a wave-soldering device, and ion milling is reported. Processing through the module fabrication and environmental testing of its design are reported. Metallization patterns by mathematical optimization are assessed. Author

**N83-10523*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ENGINEERING SCIENCES AREA AND MODULE PERFORMANCE AND FAILURE ANALYSIS AREA**
R. G. ROSS, JR. and L. D. RUNKLE *In its* Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 427-528 Apr. 1982 Prepared in cooperation with Lincoln Lab., Lexington
Avail: NTIS HC A23/MF A01 CSCL 10A

Photovoltaic-array/power-conditioner interface studies are updated. An experiment conducted to evaluate different operating-point strategies, such as constant voltage and pilot cells, and to determine array energy losses when the array is operated off the maximum power points is described. Initial results over a test period of three and a half weeks showed a 2% energy loss when the array is operated at a fixed voltage. Degraded-array studies conducted at NE RES that used a range of simulated common types of degraded I-V curves are reviewed. The instrumentation installed at the JPL field-test site to obtain the irradiance data was described. Experiments using an optical filter to adjust the spectral irradiance of the large-area pulsed solar simulator (LAPSS) to AM1.5 are described. Residential-array research activity is reviewed Voltage isolation test results are described. Experiments performed on one type of module to determine the relationship between leakage current and temperature are reviewed. An encapsulated-cell testing approach is explained. The test program, data reduction methods, and initial results of long-duration module testing are described. Author

**N83-10524*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PROJECT ANALYSIS AND INTEGRATION AREA**
R. W. ASTER and G. FOX *In its* Flat Plate Solar Array Proj.: Proc. of the 20th Proj. Integration Meeting p 529-535 Apr. 1982
Avail: NTIS HC A23/MF A01 CSCL 10A

A simulation program that investigates the relationship between manpower requirements and equipment availability in the presence

of scheduled and unscheduled maintenance is presented. A method for optimization of metallization patterns is presented. Author

**N83-10525*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PARABOLIC DISH SOLAR THERMAL POWER ANNUAL PROGRAM REVIEW, PROCEEDINGS**
J. W. LUCAS 15 Jul. 1982 347 p refs Conf. held in Atlanta, 8-10 Dec. 1981
(Contract NAS7-100; DE-AT04-81AL-16228)
(NASA-CR-169365; JPL-PUB-82-66; JPL-5105-118; DOE/JPL-106052; NAS 1.26.169365) Avail: NTIS HC A15/MF A01 CSCL 10B

The results of activities of the parabolic dish technology and applications development element of DOE's Solar Thermal Energy System Program are presented Topics include the development and testing of concentrators, receivers, and power conversion units; system design and development for engineering experiments; economic analysis and marketing assessment; and advanced development activities. A panel discussion concerning industrial support sector requirements is also documented.

**N83-10526*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DEVELOPMENT STATUS OF THE PDC-1 PARABOLIC DISH CONCENTRATOR**
T. THOSTESEN, I. F SOCZAK (Ford Aerospace and Communications Corp., Newport Beach, Calif.), and R. L. PONS (Ford Aerospace and Communications Corp., Newport Beach, Calif.) *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 3-13 15 Jul. 1982 refs
Avail: NTIS HC A15/MF A01 CSCL 10A

The status of development of the 12 m diameter parabolic dish concentrator which is planned for use with the Small Community Solar Thermal Power System. The PDC-1 unit features the use of plastic reflector film bonded to structural plastic gores supported by front-bracing steel ribs. An elevation-over-azimuth mount arrangement is employed, with a conventional wheel-and-track arrangement; outboard trunnions permit the dish to be stored in the face down position, with the added advantage of easy access to the power conversion assembly. The control system is comprised of a central computer (LSI 1123), a manual control panel, a concentrator control unit, two motor controllers, a Sun sensor, and two angular position resolvers. The system is designed for the simultaneous control of several concentrators. The optical testing of reflective panels is described. M.G.

**N83-10527*#** Acurex Corp., Mountain View, Calif.
**ACUREX PARABOLIC DISH CONCENTRATOR (PDC-2)**
P. OVERLY and R. BEDARD *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 15-20 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10A

The design approach, rationale for the selected configuration, and the development status of a cost effective point-focus solar concentrator are discussed. The low-cost concentrator reflective surface design is based on the use of a thin, backsilvered mirror glass reflector bonded to a molded structural plastic substrate. The foundation, support, and drive subassembles are described. A hybrid, two-axis, Sun tracking control system based on microprocessor technology was selected. Coarse synthetic tracking is achieved through a microcomputer-based control system to calculate Sun position for transient periods of cloud cover as well as sundown and sunrise positioning. Accurate active tracking is achieved by two-axis optical sensors. Results of the reflective panel demonstration tests investigating slope error, hail impact survivability, temperature/humidity cycling, longitudinal strength/bending stiffness, and torsional stiffness are discussed. M.G.

**N83-10528*#** Power Kinetics, Inc., Troy, N.Y.
**THE PKI COLLECTOR**
M. P. RICE *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 25-34 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10A

The design and manufacturing of a solar thermal collector is discussed. The collector has three primary subsystems: concentrator, receiver/fluid loop, and controls. Identical curved reflective columns are utilized in a faceted Fresnel design to support 864 one foot square flat inexpensive second-surface, silvered glass mirrors. The columns are ganged together and rotated through their centers of gravity to provide elevation tracking. The concentrator is supported by a lightweight spaceframe structure which distributes all wind and gravity loads to the base supports. The base of the structure is a track which rotates on wheels mounted on concrete piers. A parallel tube steel heat exchanger is mounted at the concentrator focal area in a well insulated, galvanized steel housing. Two rows of vertical close-packed, staggered tubes connect a mud header and a steam header. Automatic two axis tracking and operational control is provided with a microprocessor based package. Concentrator-mounted shadowbands are the basis for active tracking. A software program provides azimuthal tracking during cloudy periods. M.G.

**N83-10529*#** Boeing Engineering and Construction Co., Seattle, Wash.
**THIN FILM CONCENTRATOR PANEL DEVELOPMENT**
D K. ZIMMERMAN *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc p 25-34 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10A

The development and testing of a rigid panel concept that utilizes a thin film reflective surface for application to a low-cost point-focusing solar concentrator is discussed. It is shown that a thin film reflective surface is acceptable for use on solar concentrators, including 1500 F applications. Additionally, it is shown that a formed steel sheet substrate is a good choice for concentrator panels. The panel has good optical properties, acceptable forming tolerances, environmentally resistant substrate and stiffeners, and adaptability to low to mass production rates. Computer simulations of the concentrator optics were run using the selected reflector panel design. Experimentally determined values for reflector surface specularity and reflectivity along with dimensional data were used in the analysis. The simulations provided intercept factor and net energy into the aperture as a function of aperture size for different surface errors and pointing errors. Point source and Sun source optical tests were also performed. M.G.

**N83-10530*#** E-Systems, Inc., Dallas, Tex. Energy Technology Center.
**A TRANSMITTANCE-OPTIMIZED, POINT-FOCUS FRESNEL LENS SOLAR CONCENTRATOR**
M. J. ONEILL, V. R. GOLDBERG, and D. B. MUZZY *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 35-47 15 Jul. 1982 refs
Avail: NTIS HC A15/MF A01 CSCL 10A

The development of a point-focus Fresnel lens solar concentrator for high-temperature solar thermal energy system applications is discussed. The concentrator utilizes a transmittance-optimized, short-focal-length, dome-shaped refractive Fresnel lens as the optical element. This concentrator combines both good optical performance and a large tolerance for manufacturing, deflection, and tracking errors. The conceptual design of an 11-meter diameter concentrator which should provide an overall collector efficiency of about 70% at an 815 C (1500 F) receiver operating temperature and a 1500X geometric concentration ratio (lens aperture area/receiver aperture area) was completed. Results of optical and thermal analyses of the collector, a discussion of manufacturing methods for making the large lens, and an update on the current status and future plans of the development program are included. M.G.

**N83-10531*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**THE SMALL COMMUNITY SOLAR THERMAL POWER EXPERIMENT**
T. KICENIUK *In its* Parabolic Dish Solar Thermal Power Ann Program Rev., Proc. p 49-52 15 Jul. 1982 Previously announced as N81-30544
Avail: NTIS HC A15/MF A01 CSCL 10B

the objectives and current status of the Small Community Solar Thermal Power Experiment are discussed The adjustments in programs goals made in response to the changing emphasis in the area of solar energy in national policy are addressed. Planned frabication and testing activities for the test bed concentrator, power conversion assembly, and control system are outlined. M.G.

**N83-10532*#** Ford Aerospace and Communications Corp , Newport Beach, Calif. Aeronutronic Div.
**DEVELOPMENT STATUS OF THE SMALL COMMUNITY SOLAR POWER SYSTEM**
R. L. PONS *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc p 53-99 15 Jul. 1982
Avail. NTIS HC A15/MF A01 CSCL 10B

The development status and test results for the Small Community Solar Thermal Power Experiment are presented. Activities on the phase 2 power module development effoet are presented with emphasis on the receiver, the plant control subsystem, and the energy transport subsystem. The components include a single prototype power module consisting of a parabolic dish concentrator, a power conversion assembly (PCA), and a multiple-module plant control subsystem. The PCA consists of a cavity receiver coupled to an organic Rankine cycle engine-alternator unit defined as the power conversion subsystem; the PCA is mounted at the focus of a parabolic dish concentrator. At a solar insolation of 100 W/sq m and ambient temperature of 28 C (82 F), the power module produces approximately 20 kW of 3-phase, 3 kHz ac power, depending on the concentrator employed. A ground-mounted rectifier to the central collection site where it is supplied directly to the common dc bus which collects the power from all modules in the plant. M.G.

**N83-10533*#** Barber-Nichols Engineering Co , Arvada, Colo.
**ORGANIC RANKINE POWER CONVERSION SUBSYSTEM DEVELOPMENT FOR THE SMALL COMMUNITY SOLAR THERMAL POWER SYSTEM**
R. E BARBER and F. P. BODA (Ford Aerospace and Communications Corp., Newport Beach, Calif.) *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev , Proc. p 101-113 15 Jul. 1982
Avail. NTIS HC A15/MF A01 CSCL 10B

The development and preliminary test results for an air-cooled, hermetically sealed 20 kW sub E organic Rankine cycle engine/alternator unit for use with point focussing distributed receiver solar thermal power system. A 750 F toluene is the working fluid and the system features a high speed, single-stage axial flow turbine direct-coupled to a permanent magnet alternator. Good performance was achieved with the unit in preliminary tests.
M G.

**N83-10534*#** Applied Concepts Corp., Reston, Va.
**VERIFICATION TESTING OF THE PKI COLLECTOR AT SANDIA NATIONAL LABORATORIES, ALBUQUERQUE, NEW MEXICO**
J. S. HAUGER and S. L. POND *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 115-118 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10A

Verification testing of a solar collector was undertaken prior to its operation as part of an industrial process heat plant at Capitol Concrete Products in Topeka, Kansas. Testing was performed at a control plant installed at Sandia National Laboratory, Albuquerque, New Mexico (SNLA). Early results show that plant performance is even better than anticipated and far in excess of test criteria Overall plant efficiencies of 65 to 80 percent were typical during hours of good insolation. A number of flaws and imperfections were detected during operability testing, the most important being a problem in elevation drive alignment due to a manufacturing error. All problems were corrected as they occurred and the plant, with over 40 hours of operation, is currently continuing operability testing in a wholly-automatic mode R.J.F

**N83-10535*#** Applied Concepts Corp., Reston, Va
**PKI SOLAR THERMAL PLANT EVALUATION AT CAPITOL CONCRETE PRODUCTS, TOPEKA, KANSAS**
J. S. HAUGER and D. N. BORTON (Power Kinetics, Inc.) *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev , Proc. p 119-121 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

A system feasibility test to determine the technical and operational feasibility of using a solar collector to provide industrial process heat is discussed. The test is of a solar collector system in an industrial test bed plant at Capitol Concrete Products in Topeka, Kansas, with an experiment control at Sandia National Laboratories, Albuquerque. Plant evaluation will occur during a year-long period of industrial utilization. It will include performance testing, operability testing, and system failure analysis. Performance data will be recorded by a data acquisition system. User, community, and environmental inputs will be recorded in logs, journals, and files Plant installation, start-up, and evaluation, are anticipated for late November, 1981. R.J.F

**N83-10536*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**RECENT TESTS ON THE CARTER SMALL RECIPROCATING STEAM ENGINES**
T. KICENIUK and W. WINGENBACH *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 123-145 15 Jul 1982 refs
Avail. NTIS HC A15/MF A01 CSCL 10B

The Jay Carter Enterprises (JCE) Paratransit Vehicle steam engine was tested over a range of conditions which might be experienced by the power converter subsystem of the Small Community Solar Thermal Power Experiment. Some difficulties were encountered getting the engine ready for testing. These difficulties were related to the five year dormancy of the entire system and to incomplete development work that had been going on at the time of cessation of steam engine work at JCE. Other difficulties were related to the fact that the particular expander being tested never ran before and possessed some manufacturing defects. Nevertheless, the engine was operated successfully and results of testing do verify results of computer simulations of the engine in regard to the effect of temperature and power level variations Engine efficiency was good but generally lower than expected and performance dropped as testing continued. The effect of change in expansion ratio was not demonstrated because of deterioration in engine performance. Post-test inspection revealed numerous correctable defects. R.J.F.

**N83-10537*#** Mechanical Technology, Inc., Latham, N. Y.
**A 400-KWE HIGH-EFFICIENCY STEAM TURBINE FOR INDUSTRIAL COGENERATION**
H. M. LEIBOWITZ *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 147-177 15 Jul 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

An advanced state-of-the-art steam turbine-generator developed to serve as the power conversion subsystem for the Department of Energy's Sandia National Laboratories' Solar Total-Energy Project (STEP) is described. The turbine-generator, which is designed to provide 400-kW of net electrical power, represents the largest turbine-generator built specifically for commercial solar-powered cogeneration. The controls for the turbine-generator incorporate a multiple, partial-arc entry to provide efficient off-design performance, as well as an extraction control scheme to permit extraction flow regulation while maintaining 110-spsig pressure. Normal turbine operation is achieved while synchronized to a local utility and in a stand-alone mode. In both cases, the turbine-generator features automatic load control as well as remote start-up and shutdown capability. Tests totaling 200 hours were

conducted to confirm the integrity of the turbine's mechanical structure and control function. Performance tests resulted in a measured inlet throttle flow of 8,450 pounds per hour, which was near design conditions. R.J.F.

**N83-10538*#** KB United Stirling AB & Co , Malmoe (Sweden)
**MODIFICATIONS AND TESTING OF A 4-95 STIRLING ENGINE FOR SOLAR APPLICATIONS**
H. G. NELVING and W. H. PERCIVAL (United Stirling, Inc ) *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 179-189 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The modifications and testing of a standard Stirling engine, required for connection to a 25 kW induction alternator, for use with a solar thermal parabolic dish electric module is described. Power was absorbed by a GE induction alternator connected to the utility grid. Also included are the results from recent testing of another solar engine at the DOE-Georgia Tech solar site. It was done in parallel with the testing at Edwards for the purpose of comparing performance of two solar-only receivers, which were based on the standard 4-95 involute heat exchanger. R.J.F.

**N83-10539*#** Advanco Corp., El Segundo, Calif.
**DISH STIRLING SYSTEM INTEGRATION AND TEST PROGRESS REPORT**
R. A. HAGLUND *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 191-200 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The integration and check-out of a complete Dish Solar Stirling Thermal Power System is described. The preliminary results of the tests conducted thus far are presented. The results are very encouraging and show promise of high performance and efficiency The outstanding performance and durability of the 4-95 Stirling engine was the highlight of this 6 month integration and test activity. Exposure to severe heat, dust, sand and wind during the summer months and heavy rains, high winds, including sand storms and freezing cold in recent months did affected the engine or the receiver in any noticable manner. R J F.

**N83-10540*#** Advanco Corp., El Segundo, Calif.
**COMMERCIALIZATION OF PARABOLIC DISH SYSTEMS**
B. WASHOM *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 201-205 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The impact of recent federal tax and regulatory legislation on the commercialization of parabolic solar reflector technology is assessed. Specific areas in need of technical or economic improvement are noted R.J.F.

**N83-10541*#** Messerschmitt-Boelkow-Blohm G.m.b H., Munich (West Germany).
**A POINT FOCUSING COLLECTOR FOR AN INTEGRATED WATER/POWER COMPLEX**
H. ZEWEN, G. SCHMIDT, and S. MOUSTAFA (Kuwait Inst. for Scientific Research) *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 207-223 15 Jul. 1982 refs
Translation was announced as N82-23149
Avail: NTIS HC A15/MF A01 CSCL 10B

The utilization potential of the point focusing parabolic dish is identified. Its main design parameters are summarized. Performance tests and the utilization of the collector as primary energy source in a food-water-power complex are described. Process heat, heat storage, heat transfer, and cogeneration are discussed. R.J.F

**N83-10542*#** Centre National de la Recherche Scientifique, Marseilles (France). Dept. d'Heliophysique.
**THE FRENCH THERMO-HELIO-ELECTRICITY-KW PARABOLIC DISH PROGRAM**
M. AUDIBERT and G. PERI *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc p 225-231 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The testing and development of parabolic dish solar thermal power plants to produce, thermal mechanical, or electrical energy are discussed. The design, construction, and experiments of prototype collectors to prove the feasibility of such collectors is described. R.J.F.

**N83-10543*#** AiResearch Mfg. Co., Torrance, Calif.
**HIGH-TEMPERATURE CERAMIC HEAT EXCHANGER ELEMENT FOR A SOLAR THERMAL RECEIVER**
H. J. STRUMPF, D. M. KOTCHICK, and M. G. COOMBS *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 233-246 15 Jul. 1982 refs
Avail: NTIS HC A15/MF A01 CSCL 10A

A study was performed by AiResearch Manufacturing Company, a division of The Garrett Corporation, on the development a high-temperature ceramic heat exchanger element to be integrated into a solar receiver producing heated air. A number of conceptual designs were developed for heat exchanger elements of differing configuration. These were evaluated with respect to thermal performance, pressure drop, structural integrity, and fabricability. The final design selection identified a finned ceramic shell as the most favorable concept. The shell is surrounded by a larger metallic shell. The flanges of the two shells are sealed to provide a leak-tight pressure vessel. The ceramic shell is to be fabricated by an innovative combination of slip casting the receiver walls and precision casting the heat transfer finned plates. The fins are bonded to the shell during firing. The unit is sized to produce 2150 F ar at 2.7 atm pressure, with a pressure drop of about 2 percent of the inlet pressure. This size is compatible with a solar collector providing a receiver input of 85 kw(th). Fabrication of a one-half scale demonstrator ceramic receiver has been completed. B.W.

**N83-10544*#** Sanders Associates, Inc., Nashua, N. H.
**CERAMIC HIGH TEMPERATURE RECEIVER DESIGN AND TESTS**
S. B DAVIS *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. 247-255 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The High Temperature Solar Thermal Receiver, which was tested a Edwards AFB, CA during the winter of 1980-1981, evolved from technologies developed over a five year period of work. This receiver was tested at the Army Solar Furnace at White Sands, NM in 1976 The receiver, was tested successfully at 1768 deg F and showed thermal efficiencies of 85%. The results were sufficiently promising to lead ERDA to fund our development and test of a 250 kW receiver to measure the efficiency of an open cavity receiver atop a central tower of a heliostat field. This receiver was required to be design scalable to 10, 50, and 100 MW-electric sizes to show applicability to central power tower receivers That receiver employed rectagular silicon carbide panels and vertical stanchions to achieve scalability. The construction was shown to be fully scalable; and the receiver was operated at temperatures up to 2000 deg F to achieve the performance goals of the experiment during tests at the GIT advanced components test facility during the fall of 1978. B W

**N83-10545*#** Garrett Turbine Engine Co., Phoenix, Ariz.
**GARRETT SOLAR BRAYTON ENGINE/GENERATOR STATUS**
B. ANSON *In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 257-282 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The solar advanced gas turbine (SAGT-1) is being developed by the Garrett Turbine Engine Company, for use in a Brayton cycle power conversion module. The engine is derived from the advanced gas turbine (AGT101) now being developd by Garrett and Ford Motor Company for automotive use. The SAGT Program is presently funded for the design, fabrication and test of one engine at Garrett's Phoenix facility. The engine when mated with a solar receiver is called a power conversion module (PCU) The PCU is scheduled to be tested on JPL's test bed concentrator under a follow on phase of the program. Approximately 20 kw of electrical power will be generated. B.W.

**N83-10546*#** AiResearch Mfg. Co., Los Angeles, Calif.
**APPLICATION OF THE SUBATMOSPHERIC ENGINE TO SOLAR THERMAL POWER**
*In* JPL Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 283-293 15 Jul. 1982
Avail: NTIS HC A15/MF A01 CSCL 10B

The development of a natural gas-fired Brayton engine is discussed. It is intended to be the prime mover for a 10-ton commercial heat pump. This engine has many attractive features that make it an ideal candidate for solar thermal-power generation applications The unique feature of this engine is its subatmospheric mode of operation. It operates between atmospheric pressure and a partial vacuum. This means that heat is added to the cycle at atmospheric pressure; this permits the receiver to be unpressurized, greatly simplifying its design and cost. B.W.

**N83-10548*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CONFIGURATION SELECTION STUDY FOR ISOLATED LOADS USING PARABOLIC DISH MODULES**
W. REVERE, J. BOWYER, T. FUJITA, and H. AWAYA *In its* Parabolic Dish Solar Thermal Power Ann. Program Rev., Proc. p 319-328 15 Jul. 1982 refs Previously announced as A82-18223
Avail. NTIS HC A15/MF A01 CSCL 10B

A configuration tradeoff study was conducted to determine optimum solar thermal parabolic dish power systems for isolated load applications. The specific application of an essentially constant power demand as required for MX missile shelters is treated. Supplying a continuous level of power with high reliability is shown to require a power system comprising modular parabolic dish power units where the heat engines of the modular power units can be driven by fossil fuels as well as solar-derived heat. Since constraints on reliability result in the provision of a power generating capability that exceeds the constant demand level, efficient utilization of the power system requires battery storage. Tradeoffs regarding the optimum size of storage are investigated as a function of the number of power modules and the cost of the fossil fuel B.W.

**N83-10549*#** Solar Steam, Inc., Fox Island, Wash.
**AN ECONOMIC EVALUATION OF SOLAR ENERGY**
D. WOOD *In* JPL Parabolic Dish Solar Thermal Ann. Program Rev., Proc. p 329-338 15 Jul. 1982 Previously announced as A78-10615
Avail· NTIS HC A15/MF A01 CSCL 10A

The economic advantages of solar dish collectors are evaluated and compared with other energy systems. Labor, inflation and energy deregulation are considered. B.W.

**N83-10552*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**USER HANDBOOK FOR BLOCK IV SILICON SOLAR CELL MODULES**
M. I SMOKLER 1 Sep. 1982 63 p refs
(Contract NAS7-100)
(NASA-CR-169431; DOE/JPL-1012-75; JPL-PUB-82-73; NAS 1.26:169431) Avail: NTIS HC A04/MF A01 CSCL 10A

The essential electrical and mechanical characteristics of block 4 photovoltaic solar cell modules are described. Such module characteristics as power output, nominal operating voltage, current-voltage characteristics, nominal operating cell temperature, and dimensions are tabulated. The limits of the environmental and other stress tests to which the modules are subjected are briefly described. M.G.

**N83-10553*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**PHOTOVOLTAIC MODULE ENCAPSULATION DESIGN AND MATERIALS SELECTION, VOLUME 1, ABRIDGED**
E. CUDDIHY 1 Sep. 1982 40 p refs
(Contract NAS7-100; DE-AI01-76ET-20356; JPL PROJ. 5101-216)
(NASA-CR-169372; DOE/JPL-1012-77-VOL-1; JPL-PUB-82-81-VOL-1; NAS 1.26:169372) Avail: NTIS HC A03/MF A01 CSCL 10A

A summary version of Volume 1, presenting the basic encapsulation systems, their purposes and requirements, and the characteristics of the most promising candidate systems and materials, as identified and evaluated by the Flat-Plate Solar Array Project is presented. In this summary version considerable detail and much supporting and experimental information has necessarily been omitted. A reader interested in references and literature citations, and in more detailed information on specific topics, should consult Reference 1, JPL Document No. 5101-177, JPL Publication 81-102, DOE/JPL-1012-60 (JPL), June 1, 1982. Author

**N83-10554*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE EFFECT OF TA2O5 ON THE INTERACTION BETWEEN SILICON AND ITS CONTACT METALLIZATION**
V. G. WEIZER 1982 10 p refs Presented at the 16th Photovoltaic Specialists Conf., San Diego, Calif., 23 Sep. 1982; sponsored by IEEE
(NASA-TM-82948; E-1354; NAS 1.15.82948) Avail: NTIS HC A02/MF A01 CSCL 10A

Evidence is presented showing that the presence of the commonly used antireflection coating material, Ta2O5, on the free surface of contact metallization can either suppress or enhance, depending on the system, the interaction that takes place at elevated temperatures between the metallization and the underlying silicon The Ta2O5 layer is shown to suppress both the generation and the annihilation of vacancies at the metal free surface which are necessary to support metal-silicon interactions. It is also shown that the mechanical condition of the free metal surface has a significant effect on the passivating ability of the Ta2O5 layer. Author

**N83-10555*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EVALUATION OF ELECTRODE SHAPE AND NONDESTRUCTIVE EVALUATION METHOD FOR WELDED SOLAR CELL INTERCONNECTS**
C. R. BARAONA, S. J. KLIMA, T. J. MOORE, W. E. FREY, and A. F. FORESTIERI Sep. 1982 14 p refs Presented at 16th Photovoltaic Specialists Conf., San Diego, Calif., 27-30 Sep. 1982; sponsored by IEEE
(NASA-TM-82966, E-1386; NAS 1.15·82966) Avail: NTIS HC A02/MF A01 CSCL 10A

Resistance welds of solar cell interconnect tabs were evaluated. Both copper-silver and silver-silver welds were made with various heat inputs and weld durations. Parallel gap and annular gap weld electrode designs were used. The welds were analyzed by light microscope, electron microprobe and scanning laser acoustic microscope. These analyses showed the size and shape of the weld, the relationship between the acoustic micrographs, the visible electrode footprint, and the effect of electrode misalignment. The effect of weld heat input on weld microstructure was also shown. Author

**N83-10564** Missouri Univ., Columbia.
**THE FABRICATION AND EVALUTION OF A SILICON PHOTOVOLTAIC CELL WITH A DIRECTLY NITRIDED TUNNEL INSULATOR Ph.D. Thesis**
W. F. RICHARDSON 1981 84 p
Avail: Univ. Microfilms Order No. DA8205416

The fabrication of MIS solar cells with nitrided insulator films is described. A technique for low temperature growth of the insulator film by direct nitridation in active nitrogen generated by electric discharge is presented. This film is found to be very smooth and

its thickness is nearly independent of the active nitrogen exposure time. Cell performance is a strong function of exposure time and a film densification growth mechanism is proposed The nitrided cells were empirically optimized for energy conversion performance and characterized according to Schottky barrier diode theory. Physical constants governing cell operation are obtained from current voltage and capacitance voltage measurements. Active area conversion efficiencies are nominally 8 percent as compared to 8 1/2 percent nominal efficiency for similarly fabricated cells with thermally grown silicon oxide insulators. Quantum efficiencies under monochromatic illumination in the visible spectrum are shown to be higher than those of junction type cells. Dissert. Abstr.

**N83-10565** Florida Univ., Gainesville.
**METHODS FOR INVESTIGATING THE PROPERTIES OF POLYCRYSTALLINE SILICON P-N JUNCTION SOLAR CELLS Ph.D. Thesis**
J. A. MAZER 1981 153 p
Avail: Univ Microfilms Order No. DA8203696

Experimental and analytical methods are developed for investigating the properties and performance degrading mechanism of polycrystalline silicon p-n junction solar cells. The degrading effects of areal inhomogeneity are demonstrated by means of a parallel subcell equivalent circuit model. It is shown that it is the area of the poor quality material in a silicon p-n junction solar cell that dominates in determining the overall cell performance. An experimental method is developed for assessing the validity of the shifting approximation for solar cells made from polysilicon and other material The experimental data suggest that the shifting approximation is valid for a variety of polysilicon solar cells in which the intragrain base minority carrier diffusion length is small than or equal to the average grain diameter. The current components associated with the grain boundaries of diffused p-n junction polysilicon solar cells made on Wacker substrates are analyzed and experimentally identified. Dissert. Abstr.

**N83-10567*#** New Mexico Univ., Albuquerque. Bureau of Engineering Research.
**STUDY OF THE PHOTOVOLTAIC EFFECT IN THIN FILM BARIUM TITANATE Semiannual Report**
W. W. GRANNEMANN and V. S. DHARMADHIKARI Oct. 1982 23 p refs
(Contract NAG1-95)
(NASA-CR-169435; NAS 1.26:169435;
EECE-274(82)-NASA-931-1) Avail. NTIS HC A02/MF A01
CSCL 10A

The basic mechanism associated with the photovoltaic phenomena observed in the R.F. sputtered BaTiO3/silicon system is presented. Series of measurements of short circuit photocurrents and open circuit photovoltage were made. The composition depth profiles and the interface characteristics of the BaTiO3/silicon system were investigated for a better understanding of the electronic properties. A Scanning Auger Microprobe combined with ion in depth profiling were used. S.L.

**N83-10597#** General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
**DESIGN AND DEVELOPMENT OF A HIGH-CONCENTRATION PHOTOVOLTAIC CONCENTRATOR**
R. C HODGE Apr. 1982 112 p refs
(Contract DE-AC04-76DP-00789)
(DE82-015673; SAND-81-7007) Avail: NTIS HC A06/MF A01

The design and development of a high concentration photovoltaic concentrator module is discussed. The design concept incorporating a curved groove domed Fresnel lens, a high concentration etched multiple vertical junctin solar cell and a passively cooled direct-bonded copper cell mount all packaged in a plastic module is discussed. Two seven inch diameter 1200x domed Fresnel lenses were fabricated using single point diamond turning technology. Testing confirmed optical transmissin efficiencies of over 83%. Samples of the latest available cells were mounted and installed, with a domed Fresnel lens, into a prototype module. Subsequent testing demonstrated net lens-cell efficiencies of 10 to 13%. Salient conclusions were formulated as to this technology. DOE

**N83-10598#** Sandia Labs., Albuquerque, N Mex. Experimental Facilities Operations Div.
**RESULTS OF TESTING A DEVELOPMENT MODULE OF THE SECOND-GENERATION E-SYSTEMS CONCENTRATING PHOTOVOLTAIC-THERMAL MODULE**
T D. HARRISON Apr. 1982 25 p
(Contract DE-AC04-76DP-00789)
(DE82-015671; SAND-82-0701) Avail: NTIS HC A02/MF A01

An actively-cooled linear Fresnel lens concentrating photovoltaic and thermal module, designed and built by E-Systems, was tested in the Photovoltaic Advanced Systems Test Facility. Physical, electrical, and thermal characteristics of the module are presented. Module performance is characterized through the use of multiple linear regression techniques. DOE

**N83-10599#** Sandia Labs., Livermore, Calif. Solar Programs Div.
**DESIGNING THE MANIFOLD PIPING FOR PARABOLIC-TROUGH-COLLECTOR FIELDS**
J. K. SHARP Apr 1982 28 p refs
(Contract DE-AC04-76DP-00789)
(DE82-015998; SAND-81-1780) Avail: NTIS HC A03/MF A01

A simple procedure for sizing the manifold piping in parabolic-trough collector fields is presented. The proper manifold pipe sizes and insulation thicknesses are obtained without detailed optimizations of the thermal and electrical parasitics. An engineering constraint determines the pipe sizes and an insulation table lists the proper insulation thicknessess. The engineering constraint limits the pressure drop in the manifold piping to a fraction of the pressure drop in the (RADICAL)T string. This ensures output temperature control in all (RADICAL)T strings A four-step procedure is presented to size the manifold piping; tables showing the proper insulation thickness as a function of pipe size and temperature are given. DOE

**N83-10605#** Total Environmental Action, Inc., Harrisville, N.H.
**STUDY OF PHOTOVOLTAIC RESIDENTIAL RETROFITS. VOLUME 1: EXECUTIVE SUMMARY**
D. E. MAHONE, P. I. TEMPLE, J. A. ADAMS, B. B. CHALMERS, A. E. MOTTER, and A. E. MILLNER Apr. 1982 84 p 3 Vol.
(Contract DE-AC04-76DP-00789)
(DE82-015793; SAND-81-7019/1) Avail: NTIS HC A05/MF A01

The problems and potentials are analyzed for widespread residential retrofits of PV power systems. Included are data on the existing housing stock, designs for array mounting and system electrical wiring, and economic analyses for retrofits. DOE

**N83-10607#** Boeing Computer Services, Inc., Seattle, Wash.
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 7: BEVERLY HIGH SCHOOL, BEVERLY, MASS.**
Apr. 1982 30 p
(Contract DE-AC04-76DP-00789)
(DE82-015790; SAND-81-7088/7) Avail: NTIS HC A03/MF A01

Performance data are given for a grid-connected photovoltaic power supply at a Massachusetts high school for the month of March, 1982. Data presented include: daily and monthly electrical energy produced: daily and monthly array effiency; energy produced as a function of power level, voltage, cell temperature, and hour of the day, power conditioner input, output, and efficiency for two powr conditioner units and for the overall power conditioning system; daily and monthly photovoltaic energy to load and the corresponding dollar value, grid to load energy from February 17 through April 5; photovoltaic system efficiency; capacity factor; daily system availability; daily and hourly insolation; heating and cooling degree days; hourly and monthly ambient temperature; hourly and monthly wind speed; wind direction distribution; number of freeze/thaw cycles; hourly cell temperature; and data acquisition mode and recording interval plot. Also included are seven summaries of site events. DOE

**N83-10608#** Boeing Computer Services, Inc., Seattle, Wash.
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE. VOLUME 6 FOR LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, NM**
Jan. 1982 8 p
(Contract DE-AC04-76DP-00789)
(DE82-015476; SAND-81-7099/6) Avail: NTIS HC A02/MF A01

Performance data are presented for a 100 kW-peak grid connected flat panel photovoltaic power supply at a New Mexico shopping center for the month of December 1981. Data include daily and monthly electrical energy produced, daily and monthly incident solar energy in the array plane, efficiency of the array and of the power conditioner, capacity factor, insolation, and the data acquisition mode and recording interval plot. Also included is a site event report involving the operating data acquisition system. DOE

**N83-10610#** Sandia Labs., Albuquerque, N Mex. Thermophysical Properties Div.
**SOLAR HEMISPHERICAL REFLECTOMETER MODIFICATION FOR SECOND-SURFACE MIRROR MEASUREMENT**
A. R. MAHONEY May 1982 28 p refs
(Contract DE-AC04-76DP-00789)
(DE82-016913; SAND-82-0934) Avail: NTIS HC A03/MF A01

A commercial reflectometer has been modified for improved measurement of the solar hemispherical reflectance of second surface mirrors. The Solar Spectrum Reflectometer (SSR), manufactured by Devices and Services Co., Dallas, TX is designed to measure the solar hemispherical reflectance of flat, diffusely reflecting and first surface specular samples. Initial investigation of the device revealed that the SSR yielded significant deviations from the actual solar reflectance of second surface mirrors. The low reflectance values were determined to be caused by the displacement of the reflective surface away from the measurement port caused by the mirror protective layer. Instrument modifications are described which reduce the sensitivity of the instrument to second surface mirror thickness. The modifications involve enlarging both the sample port opening and the specular disk (target) located inside the measurement cavity, adjusting the lamp assembly height, and installing a diffuser over the lamp. The modified SSR demonstrated only a small linear reflectance variation with mirror displacement. It was shown that any mirror of known solar hemispherical reflectance having a thickness within the range, 0 mm (first surface) to 3.2 mm, could be used as the reflectance standard. DOE

**N83-10620#** Battelle Inst., Frankfurt am Main (West Germany). Abt. Angewandte Festkoerperphysik.
**RESEARCH AND DEVELOPMENT ON A MIS THIN FILM SOLAR CELL MADE OF AMORPHOUS SILICON Final Report, Jan. 1981**
H. JAEGER, D. BONNET, W. ROESSLER, U. BRUNSMANN, and B. FUESSL Bonn Bundesministerium fuer Forschung und Technologie Jun. 1981 81 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-079; ISSN-0340-7608; R-64.125) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe , West Germany DM 17

The sputter deposition of a-Si : H layers was investigated, using a magnetron Si cathode. This allows working at much lower dc voltages, which is advantageous for the quality of the films. The photovoltaic characteristic of the layer is considered the crucial property and guide for the development. Photovoltaic barriers were mainly Au Schottky barriers. First structures yielded open circuit voltages of up to 570 mV and short circuit current densities of 1 mA/cm squared. Several possible improvements of the layer quality are proposed. Author (ESA)

**N83-10621#** Fraunhofer-Inst. fuer Angewandte Festkoerperphysik, Freiburg (West Germany).
**SOLAR ENERGY CONVERSION BASED ON THE PRINCIPLE OF FLUORESCENT COLLECTORS Final Report, Oct. 1980**
G. BAUR, A. GOETZBERGER, K. HEIDER, H. LANGHALS, E. SAH, V. WITTWER, and A. ZASTROW Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 204 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-081; ISSN-0340-7608) Avail: NTIS HC A10/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 39

Fluorescent dyes and matrix materials were investigated with regard to an application in fluorescent collectors. In the visible range, dyes from the field of display applications were available In this spectral range, the combination organic dye - plexiglass gives satisfactory results concerning efficiency as well as stability, The first collectors were tested in a long term outdoor test setup. In the red and infrared range, the properties of dyes and collectors are not yet satisfactory. Author (ESA)

**N83-10622#** Schott Glaswerke, Mainz (West Germany).
**DEVELOPMENT OF LARGE SCALE PRODUCTION METHODS FOR COMPONENTS OF SOLAR ENERGY COLLECTION. TRANSPARENT GLASS COVERS AND THEIR CONNECTION TO THE COLLECTOR SYSTEM Final Report, Mar. 1980**
E. HUSSMANN Bonn Bundesministerium fuer Forschung und Technologie Jun 1982 52 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-083; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11

The problems connected with the glass cover of flat solar collectors to be produced on a large scale are identified and solved. The glass pane cover of flat plate solar collectors and its connection to the collector can be selected only when all the mechanical and thermal stresses are known during operation. Loads from the environment as wind, snow, ice and hail were investigated. The loads due to operation as pressure rise related to temperature rise and thermal stresses are analyzed. The connection between glass panes and collector, cementing and fastening into a frame, were investigated. The effective strength of glass panes, thermally strengthened and not strengthened, is described extensively. These methods to calculate and predict the stresses in the cover plate and its connection to the collector are demonstrated by an example. Author (ESA)

**N83-10626#** Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany). Abteilung EPS.
**TESTS WITH CONCENTRATING COLLECTORS Final Report, Jun. 1981**
M. KRAFT Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 82 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-104; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 17

The parabolic solar absorber Helioman 3-32/A was developed. Before going over to industrial use in large solar plants, a complete module with all auxiliary equipment was tested. The standards for acceptability and quality were established, a module of six absorbers with tracking and automatic control systems was constructed, simulation tests were conducted, and real conditions tests were run at a solar energy test center. The results of simulation tests, the calculation of foundations, the choice of the reflector material, the starting-up procedure, and the running conditions are reported. Author (ESA)

**N83-10632#** Konstanz Univ. (West Germany). Fakultaet fuer Physik.
**INVESTIGATION OF NEW SOLAR CELLS. PART A: NOVEL SEMICONDUCTORS AND THEIR SUITABILITY. PART B: POLYCRYSTALLINE MIS DIODES Final Report, Dec. 1980**
E. BUCHER and P. MUNZ Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 32 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-103, ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 6,50

Solar cells were explored with Be, Yb, Sc, Y, Hf as barrier metals; Sc proved to be the best one. For the first time, a surface as large as three and a quater sq.cm. was obtained. It was proved that n-Si and n-SiIso MIS cells with Au and Pt were inferior to p-type cells. Sintering of Si powder wafers was achieved by capacitor discharge. Photovoltaic materials as Zn3P2, Wse2, InSc were explored. Production of solar cells by MIS technology-Si-powder-cells and metallurgy methods were studied. No stable cells are yet found due to chemical surface problems Barrier metals such as Be, Sc, Hf and related elements can be used for p-Si MIS cells with good performances. They are considerabely more stable than n-Si cells. Among alternative materials, p-WSe2 appears to be the most promising material for p/n MIS and photoelectrochemical cells. Author (ESA)

**N83-10718#** Technische Hochschule, Darmstadt (West Germany). Inst. fuer Meteorologie.
**DETERMINATION OF CLIMATOLOGICAL PARAMETERS OF GLOBAL RADIATION AND DIRECT SOLAR RADIATION FOR HORIZONTAL, NOT HORIZONTAL, FIXED AND NORMAL INCIDENT RADIATION ABSORBER Final Report, Jan. 1980**
G. MANIER and H. FUCHS Bonn Bundesministerium fuer Forschung und Technologie May 1982 36 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-070; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 7,50

Solar radiation data were gathered. The data acquisition system consisted of five horizontal receivers, four inclined receivers, two tracking receivers, and one solar radiation indicator. Meteorological parameters were cloud cover, altitude of lower cloud cover, type of weather conditions. Half hourly sums of global, diffuse and direct solar radiation as well as the time percentage of direct solar radiation, the number, mean duration, and scatter of sunshine periods as calculated by computer. The investigations on the relationship between direct and diffuse solar radiation and synoptic weather observations were extrapolated on measurements taken over 8 years. The differences between measured and calculated monthly radiation sums are always smaller than 0.5 kWh/m2.
Author (ESA)

**N83-10902** California Inst. of Tech., Pasadena.
**THE LUMINESCENT SOLAR CONCENTRATOR Ph.D. Thesis**
J. S. BATCHELDER 1982 286 p
Avail: Univ. Microfilms Order No. DA820334

The luminescent solar concentrator (LSC) allows sunlight to be concentrated through the use of light pipe trapping of luminescence. Such concentrators do not require tracking, and they can reduce the cost of solar energy conversion by reducing the required area of photovoltaic cells. The spectral characteristics of 18 organic laser dyes are studied for their applicability as luminescing centers. The spectral homogeneity and self absorption characteristics of representative dyes are examined The relative spectral homogeneity of such dyes is shown to depend upon the surrounding material using narrow band laser excitation. Three independent techniques for measuring self absorption rates are developed; these are time resolved emission, steady state polarization anisotropy, and spectral convolution. Prototype devices are tested for performance, and the component dyes are tested for stability to solar exposure Dissert. Abstr.

**N83-10962*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**RADIATION DAMAGE IN FRONT AND BACK ILLUMINATED HIGH RESISTIVITY SILICON SOLAR CELLS**
I WEINBERG, C. GORADIA, C. K. SWARTZ, and H. W. BRANDHORST, JR. 1982 12 p refs Presented at 16th Photovoltaic Specialists Conf., San Diego, Calif., 27-30 1982; sponsored by IEEE
(NASA-TM-82965; E-1384; NAS 1.15:82965) Avail: NTIS HC A02/MF A01 CSCL 10A

Radiation induced degradation, in front and back illuminated 84 and 1250 ohm-cm n+pp+ silicon solar cells, was determined and cell performance interpreted using calculated optically injected charge distributions and cell voltage components. The 84 ohm-cm cell degraded less when illuminated from the front or n+ side compared to that when illuminated from the back or p+ side. On the other hand, the 1250 ohm-cm cell degraded less when back illuminated. It is concluded that, in addition to the usual mechanisms leading to decreased collection efficiencies, loss of conductivity modulation is a major cause of radiation damage in high resistivity silicon solar cells. These results suggest that radiation damage to high resistivity n+pp+ cells can be decreased by increasing cell collection efficiency and illuminating the cells from the p+ side.
Author

**N83-11585#** Sandia Labs., Albuquerque, N. Mex.
**EFFICIENCY-IMPROVEMENT STUDY FOR GAAS SOLAR CELLS Final Report, 31 Mar. 1980 - 30 Sep. 1981**
J. A. CAPE, J. R. OLIVER, and S W. ZEHR Apr. 1982 178 p refs Prepared in cooperation with Rockwell International Corp., Thousand Oaks, Calif.
(Contract DE-AC04-76DP-00789)
(DE82-016410; SAND-82-7105) Avail: NTIS HC A09/MF A01

High yield fabrication of good quality AlGaAs/GaAs concentration solar cells has been a limiting factor in widespread utilization of these high conversion efficiency (22 to 24%) photovoltaic cells. Reported is a series of investigations to correlate solar cell yield with substrate quality, growth techniques, layer composition, and metallization processes. In addition, several diagnostic techniques are described to aid in device characterization. DOE

**N83-11586#** Pacific Northwest Lab., Richland, Wash.
**EVALUATION OF SOLAR-AIR-HEATING CENTRAL-RECEIVER CONCEPTS**
S. P. BIRD, M. K. DROST, T. A. WILLIAMS, D. R. BROWN, J. A. FORT, B. A. GARRETTPRICE, S. G. HAUSER, M A. MCLEAN, A. M. PALUSZEK, and J. K. YOUNG Jun. 1982 140 p refs
(Contract DE-AC06-76RL-01830)
(DE82-016924; PNL-4003) Avail: NTIS HC A07/MF A01

The potential of seven proposed air-heating central receiver concepts are evaluated based on an independent, uniform of each one's performance and cost. The concepts include· metal tubes, ceramic tubes, sodium heat pipes, ceramic matrix, ceramic domes, small particles, and volumetric heat exchange. The selection of design points considered in the analysis, the method and ground rules used in formulating the conceptual designs are discussed, and each concept design is briefly described. The method, ground rules, and models used in the performance evaluation and cost analysis and the results are presented. DOE

**N83-11588#** Boeing Computer Services, Inc , Seattle, Wash.
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 10. NEWMAN POWER STATION, EL PASO, TEX.**
Apr. 1982 23 p
(Contract DE-AC04-76DP-00789)
(DE82-015791; SAND-81-7086/10) Avail: NTIS HC A02/MF A01

Performance data are presented for a photovoltaic power supply at a Texas utility for the month of March, 1982. Data given include: daily and monthly electrical energy produced; daily and monthly solar energy incident in the array plane; daily and monthly efficiency;

energy production as a function of power level, voltage, cell temperature, and hour of the day; daily and monthly photovoltaic power to the load and the corresponding dollar value; capacity factor; daily availability; daily and hourly insolation; daily and hourly ambient temperature; daily and hourly wind speed; wind direction distribution; hourly cell temperature; heating and cooling degree days; number of freeze and thaw cycles; and data acquisition mode and recording interval plot. Also included is an operations and maintenance report summarizing two events DOE

**N83-11589#** Boeing Computer Services, Inc., Seattle, Wash
**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 10. LOVINGTON SQUARE SHOPPING CENTER, LOVINGTON, N. MEX. (USA)**
Apr. 1982 29 p
(Contract DE-AC04-76DP-00789)
(DE82-015792; SAND-81-7085/10) Avail: NTIS HC A03/MF A01

Performance data are presented for a photovoltaic power supply at a New Mexico shopping center for the month of March, 1982. Data given include: daily and monthly electrical energy produced; daily and monthly solar energy incident in the array plane; daily and monthly efficiency; energy produced as a function of power level, voltage, cell temperature, and hour of the day; power conditioner input, output, and efficiency for two units and for the overall power conditioning system; daily and monthly photovoltaic energy supplied to the load and the corresponding dollar value, system efficiency; capacity factor; daily availability; daily and hourly insolation, ambient temperature, and wind speed; hourly cell temperature, wind direction distribution; heating and cooling degree days; number of freeze and thaw cycles, and the data acquisition mode and recording interval plot. Also included is a report of operation and maintenance for the month. DOE

**N83-11598#** Kernforschungsanlage, Juelich (West Germany).
**PROTOTYPE SOLAR HOUSE. STUDY OF THE SCIENTIFIC EVALUATION AND FEASIBILITY OF A RESEARCH AND DEVELOPMENT PROJECT Final Report, Apr. 1981**
V. BUNDSCHUH, J. W. GRUETER, M. KLEEMANN, M. MELIS, H J. STEIN, H. J. WAGNER, A. DITTRICH (Gesellschaft zur Foerderung der Heizungs- und Klimatechnik mbH), and D POHLMANN (Gesellschaft zur Foederung der Heizungs- und Klimatechnik mbH) Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 74 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-137; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15,50

A preliminary study was undertaken before a large scale project for construction and survey of about a hundred solar houses was launched. The notion of solar house was defined and the use of solar energy (hot water preparation, heating of rooms, heating of swimming pool, or a combination of these possibilities) were examined. A coherent measuring program was set up. Advantages and inconveniences of the large scale project were reviewed. Production of hot water, evaluation of different concepts and different fabrications of solar systems, coverage of the different systems, conservation of energy, failure frequency and failures statistics, durability of the installation, investment maintenance and energy costs were retained as study parameters. Different solar hot water production systems and the heat counter used for measurements are described. Author (ESA)

**N83-11605#** Swedish Council for Building Research, Stockholm.
**DURABILITY OF SOLAR COLLECTORS: EXPERIENCE FROM SURVEYS OF SWEDISH SOLAR COLLECTOR INSTALLATIONS, 1979 - 1980**
O LAGERKVIST and H. WENNERHOLM 1982 64 p refs
(PB82-188095, D1.1982; ISBN-91-540-3609-7) Avail: NTIS HC A04/MF A01 CSCL 13A

Solar heating installations were surveyed during the autumn of 1979 and spring of 1980, with a view to identifying damage occurring to solar collectors and problems related to their design and materials, and of attempting to ascertain the reasons therefore. The installations which were investigated were in operation for periods ranging from about a month to up to about five years. GRA

**N83-11608#** National Bureau of Standards, Washington, D.C Center for Building Technology.
***SOLAR AVAILABILITY IN CITIES AND TOWNS: A COMPUTER MODEL Final Report***
K. RUBERG Mar. 1982 237 p refs
(Contract DE-AI01-76PR-06010)
(PB82-202201, NBSIR-82-2498) Avail. NTIS HC A11/MF A01 CSCL 10A

An interactive computer program, SOLITE, which was written to determine the incident solar radiation on urban building surfaces, street surfaces and rooms facing urban street canyons is discussed. Hourly weather data and surface descriptors are interactively entered by the user. Solar radiation data are calculated with NOAA weather tape (TMY or TRY) cloud data using the Kimura/Stephenson cloud cover algorithm. The SOLITE also calculates solar radiation transmission through user specified glazing assemblies. Shadows cast by surrounding buildings and overhangs and interreflection effects in street canyons are captured. Internal heat gains from occupants and lighting, and daylight availability on the workplane of a room are calculated. Output options include weather data summaries, incident insolation, occupant heat gain in rooms and useable hours of daylight in a room with a given occupancy. Either hourly or daily values may be specified as output. GRA

**N83-12287#** National Bureau of Standards, Washington, D.C. National Engineering Lab.
**ANALYTICAL AND EXPERIMENTAL ANALYSIS OF PROCEDURES FOR TESTING SOLAR DOMESTIC HOT WATER SYSTEMS Final Report**
A. H. FANNEY, W. C. THOMAS, C. A SCARBROUGH, and C. P. TERLIZZI Feb. 1982 161 p refs Prepared in cooperation with the Virginia Polytechnic Inst and State Univ. Sponsored in part by DOE
(PB82-184839; NBS-BSS-140-LC-81-600191) Avail: NTIS HC A08/MF A01 CSCL 13A

Three experimental techniques which allow the net thermal output of an irradiated solar collector array to be reproduced indoors without the use of a solar simulator are investigated. These techniques include use of an electric heat source only, use of a nonirradiated collector array in series with an electric heat source, and the use of electric strip heaters which are attached to the back of nonirradiated absorber plates. Expressions are developed to compute the input power required for each experimental technique. Solar collectors connected in parallel and series combinations are considered. GRA

**N83-12386#** California Univ., Berkeley. Dept. of Mechanical Engineering.
**INVESTIGATION OF FREE-FORCED CONVECTION FLOWS IN CAVITY-TYPE RECEIVERS Progress Report, 1 Oct. 1980 - 30 Sep. 1981**
J. A. C. HUMPHREY, F. S. SHERMAN, K. S. CHEN, and W. M. TO Jul. 1982 15 p refs
(Contract DE-AC04-76DP-00789)
(DE82-020118; SAND-82-8190) Avail: NTIS HC A02/MF A01

A numerical calculation procedure applicable to cavity-type solar receiver configurations and flow conditions was developed. Air

flow visualization experiments were performed, and experimental measurements of quantities valuable for the development of the numerical calculation procedure were made. The investigation is focussed on a configuration which is strongly two dimensional in the mean flow structure (but turbulent in a truly three dimensional sense). DOE

**N83-12538#** Automation Industries, Inc , Silver Spring, Md. Vitro Labs. Div

**STEVENS HOME, RANCHO SANTA FE, CALIFORNIA: SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, OCT. 1981 - APR. 1982**

P. E. WETZEL 1982 73 p refs

(Contract DE-AC01-79CS-30027)

(DE82-021698; SOLAR/1118-82/14) Avail: NTIS HC A04/MF A01

Performance data on a solar water heating system are given. The Stevens Home in Califorina is a single family residence whose active solar energy system is designed to supply 70% of the hot water load. The system is equipped with 68 square feet of flat plate collectors, a 120 gallon solar preheat water tank, and a 40 gallon propane water heater. The solar fraction predicted by computer simulation and measured were the same, 44% The system solar savings ratio, conventional fuel savings, and solar system coefficient of performance for the period covered are given. Monthly performance data are tabulated for the overall system and for the collector, storage, and domestic hot water subsystems. System operation is illustrated for a typical day by graphs of the temperatures at collector array, inlet and outlet, and at the preheat tank, and of water consumption The typical operating sequence and solar energy use and heat losses are also graphed. DOE

**N83-12539#** Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.

**KALIN HOME, LONG ISLAND, NEW YORK: SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, SEP. 1981-MAR. 1982**

B. D. HOWARD 1982 78 p refs

(Contract DE-AC01-79CS-30027)

(DE82-021701; SOLAR/1117-82/14) Avail: NTIS HC A05/MF A01

Performance data on a solar water heating system are given. The Kalin Home is a single family residence in East Meadow, Long Island, New York whose active solar energy system is designed to supply 60% of the hot water load. The system is equipped with 2 flat plate collectors with a combined area of 48 square feet and a 120-gallon tank for storage Auxiliary heating is provided by a 4.5 kW single-element electric heater interfaced to off-peak power metering equipment to deliver auxiliary energy from midnight through 7:00 AM. Performance data for the total reporting period are summarized. In addition, monthly performance data are tabulated for the overall system and or the collector and domestic hot water subsystems. Predicted performae and performance measured during previous systems are also given for comparison. System operation for a typical day is illustrated by graphs of temperatures at various points in the system vs. time and by hourly water consumption graphs. A typical system operating sequence and solar energy utilization and heat losses are also graphed. (LEW) DOE

**N83-12540#** Automation Industries, Inc., Silver Spring, Md Vitro Labs. Div.

**EROS DATA CENTER, SIOUX FALLS, SOUTH DAKOTA: SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, OCT. 1981 - APR. 1982**

P. E. WETZEL 1982 76 p refs

(Contract DE-AC01-79CS-30027)

(DE82-021703; SOLAR/2122-82/14) Avail: NTIS HC A05/MF A01

Performance data on a solar water heating system are given. The EROS Data Center in South Dakota is a government facility whose active solar energy system is equipped with 9124 square feet of flat plate collectors, 26,893 gallons of hot water storage in an underground vault, and two auxiliary electric hot water boilers. The system provided 40% of the hot water load for the recording period. Other performance data for the period include the solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance Monthly performance data are tabulated for the system overall and for the collector and hot water subsystems. System operation for a typical day is illustrated by graphs of insolation and collector and storage temperatures versus time and of typical water consumption The typical operating sequence is also graphed. GRA

**N83-12543#** Sandia Labs., Albuquerque, N Mex.

**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT. VOLUME 3: BEVERLY HIGH SCHOOL, BEVERLY, MASSACHUSETTS**

Dec. 1981 41 p refs

(Contract DE-AC04-76DP-00789)

(DE82-006236; SAND-81-7088-3) Avail: NTIS HC A03/MF A01

Software and hardware problems resulted in the loss of sixteen days of data during September. The total electrical energy produced by the PV system during September is listed as 3986 kWh The meter is manually read only about every other month, but readings which bracket a majority of the days of the month of September indicate an average daily output of 220 kWh per day or 6600 kWh total for the month. Using the average inverter efficiency of 88 percent, shown in report Module 4, infers that the array produced 7500 kWh of dc output energy during September Similar analysis for October, when data was collected for 26 of 31 days, infers that total system output for the full 31 days was approximately 6800 kWh rather than the recorded value of 5782 kWh. DOE

**N83-12545#** Pacific Northwest Lab , Richland, Wash.

**A SURVEY OF SPECTRAL RESPONSE MEASUREMENTS FOR PHOTOVOLTAIC DEVICES**

J. S HARTMAN and M. A. LIND Nov. 1981 37 p refs

(Contract DE-AC06-76RLO-1830)

(DE82-006221; PNL-3970) Avail: NTIS HC A03/MF A01

A survey of the photovoltaic community was conducted to ascertain the present state-of-the-art for PV spectral response measurements. Specific topics explored included measurement system designs, good and bad features of the systems, and problems encountered in the evaluation of specific cell structures and materials. The survey showed that most spectral response data are used in diagnostic analysis for the optimization of developmental solar cells Measurement systems commonly utilize a chopped narrowband source in conjunction with a constant bias illumination which simulates the ambient end use environment Researchers emphasized the importance of bias illumination for all types of cells in order to minimize the effects of nonlinearities in cell response. Not surprisingly single crystal silicon cells present the fewest measurement problems to the researcher and were studied more thoroughly than any other type of solar cell. But, the accurate characterization of silicon cells is still difficult and laboratory intercomparison studies yielded data scatter ranging from + -5% to + -15%. DOE

**N83-12547#** Lincoln Lab., Mass. Inst. of Tech., Lexington.

**J. F. LONG EXPERIMENTAL PHOTOVOLTAIC HOUSE Final Report**

Jun. 1982 180 p Prepared in cooperation with Long (John F.) Properties, Inc

(Contract DE-AC02-76ET-20279)

(DE82-020506; DOE/ET-20279/201) Avail: NTIS HC A09/MF A01

A photovoltaic system was installed and monitored for one year at a three-bedroom, two-bath residence located in the suburbs of Phoenix, Arizona. The roof consists of 120 solar modules divided into five sub-arrays. The output is converted to ac and the system is grid-connected. The performance of the system overall, of the photovoltaic arrays, inverter, utility interface, and data acquisition system were measured and discussed Public acceptance of the

system is also discussed. The system is illustrated, and performance data are extensively tabulated and graphed. DOE

**N83-12548#** General Electric Co., Philadelphia, Pa. Energy Systems and Technology Div.
**ANALYSIS OF SMALL COMMERCIAL PHOTOVOLTAIC APPLICATIONS**
J. HERZ, R. ALLRED, and R. MCCARTHY Jul. 1982 162 p refs
(Contract DE-AC04-76DP-00789)
(DE82-020924; SAND-81-7172) Avail: NTIS HC A08/MF A01

The objective was to determine promising small commercial (to 500 kW) grid connected photovoltaic applications. Twelve applications were evaluated, including detailed performance and economic analyses covering different collector types, utility rate structures and geographic locations. The attractiveness of battery storage was also examined. DOE

**N83-12549#** Washington State Energy Office, Olympia.
**PASSIVE SOLAR ENERGY IN WASHINGTON: RESULTS OF THE WASHINGTON PASSIVE SOLAR DESIGN/BUILD/COMPETITION**
Mar. 1982 56 p
(Contract DE-FG06-79RO-00003)
(DE82-020394; WAOENG-82-11) Avail: NTIS HC A04/MF A01

The Washington Passive Solar Design and Build Competition was held in an effort to encourage the design, construction, and marketing of moderately priced passive solar homes in Washington state. Four categories were established, including single and multi-family, new design and remodel. A number of commonly made thermal mistakes are discussed. Eight winning entries are presented along with four notable entries, for each of which is given as an overview of the design, energy conservation measures, passive heating and cooling features, system operation, and thermal performance. DOE

**N83-12550#** Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
**HIGH-INTENSITY SOLAR CELLS Annual Report**
R. J. SCHWARTZ, M. S. LUNDSTROM, and J. L. GRAY Jul. 1982 93 p refs
(Contract DE-AC04-76DP-00789)
(DE82-020420; SAND-82-7122) Avail: NTIS HC A05/MF A01

Described is a program to support an effort to develop high-efficiency, high-concentration solar cells. During the past year this support took the following forms: providing general analytic support for the development of high-efficiency solar cells, and developing a two-dimensional computer code suitable for modelling the performance of the solar cell and othe high concentration cells currently under development. DOE

**N83-12552#** Stanford Univ., Calif. Center for Materials Research.
**ELECTROLYTIC DEPOSITION OF LOW-COST, HIGH-PURITY POLYSILICON SUITABLE FOR USE IN SOLAR-CELL DEVICES Final Technical Report**
R. S. FEIGELSON, R. A. HUGGINS, and D ELWELL Mar. 1982 39 p refs
(Contract DE-AM03-76ER-70067)
(DE82-012428; DOE/ER-70067-T1; CMR-81-16) Avail: NTIS HC A03/MF A01

Two processes were developd for the commercial production of low cost solar silicon. In the first, silicon is deposited at about 7450 C onto a graphite substrate from a solution of K2SiF6 in the binary KF/LiF or ternary LiF/NaF/KF entectic. The second process involves the deposition of silicon at temperatures above its melting point. Electrodeposition of silicon in the form of coherent, inclusion-free film was achieved, and a 99.999% purity level was attained. An average grain size over 100 microns was attained in films 100 to 200 microns thick, with good film uniformity and good carrier mobility. Electrodeposition of silicon above its melting point was attained at very rapid deposition rates. The purity of this material was close to that required for a source material for pulling or casting of crystals for solar cells. DOE

**N83-12553#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**DATA REPORT FOR THE NORTHEAST RESIDENTIAL EXPERIMENT STATION, MAY 1982**
M. C. RUSSELL, P. RAGHURAMAN, and P. C. MAHONEY Jun. 1982 20 p refs
(Contract DE-AC02-76ET-20279)
(DE82-020398; DOE/ET-20279-220) Avail: NTIS HC A02/MF A01

Tabulated are physical performance data for the month of May 1982 obtained from photovoltaic energy systems. Five prototype residential photovoltaic systems are presently under test, each consisting of a roof-mounted photovoltaic array sized to meet at least 50% of the annual electrical demand of an energy-conserving house. In addition to these prototype residential photovoltaic systems are presently under test, each consisting of a roof-mounted photovoltaic array sized to meet at least 50% of the annual electrical demand of an energy-conserving house. In addition to these prototype systems and monitored houses, one full-sized photovoltaic residence is being monitored in Carlisle, Massachusetts. The features of the prottype systems and monitored houses are tabulated, and the monthly summary tabulates meteorological information, monitored house information, and data for the photovoltaic array and power conditioning unit and the utility interface For each hour of an average day of the month and for each house, there is tabulated the total electric energy used, array output, inverter output, inverter power, load imposed on the prototype, energy supplied to and by the utility, solar array panel temperature, and total tilt insolation. DOE

**N83-12554#** Total Environmental Action, Inc., Harrisville, N.H.
**DESIGN AND FABRICATION OF A PROTOTYPE SYSTEM FOR PHOTOVOLTAIC RESIDENCES IN THE SOUTHWEST Final Report**
Jun. 1982 62 p Sponsored in part by New Mexico Solar Energy Inst and Lincoln Lab., Lexington
(Contract DE-AC02-76ET-20279)
(DE82-020783; DOE/ET-20279/209) Avail: NTIS HC A04/MF A01

Described are the design of a photovoltaic powered residence for the American Southwest, dubbed Casa fotovoltaica, and the construction of a prototype building at the Southwest Residential Experiment Station for testing the performance of the full size photovoltaic (PV) system. Included are architectural drawings of both the residence and the prototype, analysis of the energy requirements of the residence, prediction of PV system output, description of the electrical system, and history of the construction process of the prototype. DOE

**N83-12555#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**SIMULATION OF THERMAL ASPECTS OF RESIDENTIAL PHOTOVOLTAIC SYSTEMS**
G. W. HART and P. RAGHURAMAN Jun. 1982 37 p refs
(Contract DE-AC02-76ET-20279)
(DE82-020399; DOE/ET-20279/202) Avail. NTIS HC A03/MF A01

A program was developed to simulate the performance of utility interactive residential photovoltaic (PV) energy systems. The PV system is divided into its major functional components, which are individually described with computer models. These models are described in detail. The results of simulation and actual measured data are compared. The thermal influences on the design of such PV energy systems are given particular attention. DOE

**N83-12556#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**DATA REPORT FOR THE SOUTHWEST RESIDENTIAL EXPERIMENT STATION, MAR. 1982**
M. LIEBERMAN, F DURAND, G HOCKING, and C. WHITAKER 26 May 1982 25 p refs Prepared in cooperation with New Mexico Energy Inst., Las Cruces
(Contract DE-AC02-76ET-20279)
(DE82-020400; DOE/ET-20279/197) Avail. NTIS HC A02/MF A01

Physical performance data obtained from the photovoltaic energy systems under test at the Southwest Residential Experiment Station in New Mexico are tabulated for the month of March 1982. Eight prototype residential photovoltaic systems are under test, each consisting of roof-mounted photovoltaic array sized to meet at least 50% of the annual electric demand of an energy-conserving house. An enclosed structure houses the remainder of the photovoltaic system equipment, test instrumentation, and work space Each system is grid-connected. Features of the residential photovoltaic systems and monitored houses are tabulated A monthly summary is provided of meteorological data, monitored house information, and photovoltaic array, power conditioning unit, and utility interface data. Monthly averages for each hour of an average day are given of total electric energy used by each house, and of array output, inverter output, load, energy supplied to and by utility, maximum power, and total tilt insolation for each prototype system Energy histograms are provided for each prototype system. DOE

**N83-12557#** Department of Energy, Portland, Oreg Power Administration.
**SOLAR HOME SHOW: HOMES DESIGNED FOR THE SOLAR HOMEBUILDERS PROGRAM**
Jul. 1982 23 p refs
(DE82-020255, DOE/BP-125) Avail: NTIS HC A02/MF A01

Ten passive solar homes are presented that resulted from a program to demonstrate that passive solar homes can be attractive, affordable, functional, and therefore, marketable. For each home is given: the designer and builder, floor plans, perspective of the outside, passive solar and conservation features, and a comparison of the estimated heating bill for the house and a conventional house the same size. A brief discussion is included on the basics of passive solar design, ventilation and cooling, and solar access. DOE

**N83-12558#** Brookhaven National Lab., Upton, N. Y.
**HARNESSING THE SUN FOR DEVELOPMENT: ACTIONS FOR CONSIDERATION BY THE INTERNATIONAL COMMUNITY AT THE UN CONFERENCE ON NEW AND RENEWABLE SOURCES OF ENERGY FOR PROMOTING THE USE OF RENEWABLE ENERGY IN DEVELOPING COUNTRIES**
D J. JHIRAD, V. MUBAYI, and J. WEINGART (California Univ., Lawrence Berkeley Lab.) Inc.) Aug. 1981 195 p refs Sponsored in part by the Agency for International Development Prepared in cooperation with Teknekron, Inc., Berkeley)
(Contract DE-AC02-76CH-00016)
(DE82-020273; BNL-51463) Avail: NTIS HC A09/MF A01

The technical and economic evidence is reviewed for solar industrial process heat, highlighting the fact that financial parameters such as tax credits and depreciation allowance play a very large role in determining the economic competitiveness of solar investments. An analysis of the energy (and oil) consumed in providing industrial process heat in a number of selected developing countries is presented. Solar industrial process heat technology is discussed including the operating experience of several demonstration plants in the US Solar ponds are also described briefly. A financial and economic analysis of solar industrial process heat systems under different assumptions on future oil prices and various financial parameters is given. Financial analyses are summarized for a solar industrial process heat retrofit of a brewery in Zimbabwe and a high efficiency system operating in financial conditions typical of the US and a number of other industrialized nations. A set of recommended policy actions for countries wishing to enhance the commercial feasibility of renewable energy technologies in the commercial and industrial sections is presented. DOE

**N83-12560#** Monsanto Research Corp., Dayton, Ohio.
**SUPERIOR HEAT-TRANSFER FLUIDS FOR SOLAR HEATING AND COOLING APPLICATIONS. RESULTS OF ACUTE ORAL-TOXICITY DETERMINATIONS Final Report, 15 Sep. 1980 - 30 Apr. 1981**
L. PARTS and D L. CONINE (Hill Top Research, Cincinnati) Nov. 1981 36 p refs
(Contract DE-AC04-78CS-35356)
(DE82-002758, MRC-DA-1096-VOL-1) Avail: NTIS HC A03/MF A01

Acute oral toxicity tests were conducted with 22 different heat transfer fluids used in solar collectors. Included among these were three fluids that had been used in collector installations for periods of 1 to 3 years. The acute toxicological properties for transfer fluids when ingested by rats are examined. Their Gosselin's acute oral toxicity ratings range from 1 to 3. It is suggested that the acute oral toxicity of fluids used in solar collectors is sufficiently low that accidental ingestion of doses to produce a lethal effect is not very probable in normal use. By Gosselin's rating system, undiluted ethylene glycol based fluids are classified by toxicity rating of 2 whereas propylene glycol based fluids have the rating 1. It is found that the use of ethylene glycol and propylene glycol based fluids for 1 year, and of an aliphatic hydrocarbon type fluid for 3 years, do not increase their acute toxicological properties significantly DOE

**N83-12562#** North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Electrical Engineering.
**SOLAR-CELL TESTING AND EVALUATION**
E. K. STEFANAKOS and W. J. COLLIS Apr. 1982 43 p refs
(Contract DE-AC04-76DP-00789)
(DE82-016179; SAND-81-7194) Avail: NTIS HC A03/MF A01

A two year study of the degradation effects in AlGaAs/GaAs solar cells is described. Illuminated current-voltage measurements were made during temperature and humidity cycling and time dependent degradation measurements were recorded. DOE

**N83-12563#** Borg-Warner Corp., Los Angeles, Calif
**SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, CATHEDRAL SQUARE, BURLINGTON, VERMONT, JULY - DECEMBER 1981**
K. M. WELCH 1981 83 p refs
(Contract DE-AC01-79CS-30027)
(DE82-016999; SOLAR/1060-82/14) Avail: NTIS HC A05/MF A01

A 10 story multiunit aparatment building has an active solar energy system which is designed to supply 51% of the hot water load, and consists of 1798 square feet of flat plate collectors, a 2699 gallon water tank in an enclosed mechanical room on the roof, and two auxiliary natural gas boilers to supply hot water to an immersed heat exchanger in an auxiliary storage tank. The measured solar fraction was only 28%, not 51%, which, it is concluded, is an unreasonable expectation. Other performance data include the solar savings ratio, conventional fuel savings, system performance factor, and solar system coefficient of performance. Monthly performance data are given for the solar system overall, and for the collector, storage, and hot water subsystems. Insolation data, typical storage fluid temperatures, domestic hot water consumption, and solar heat exchangers inlet-output temperatures, and typical domestic hot water subsystem temperatures are also included. In addition, the system operating sequence, solar energy utilization A system description, performance evaluation techniques, and long term weather data are given DOE

**N83-12566#** TEA, Inc., Harrisville, N.H.
**STUDY OF PHOTOVOLTAIC RESIDENTIAL RETROFITS. VOLUME 2: MAIN REPORT**
D. E. MAHONE, P. L. TEMPLE, J. A. ADAMS, B. B. CHALMERS, A. D. MOTTER, and A E. MILLNER Apr. 1982 267 p refs Prepared in cooperation with TriSolar Corp.
(DE82-015626; SAND-81-7019-VOL-2) Avail: NTIS HC A12/MF A01

The problems an potentials for widespread residential retrofits of PV power systems are analyzed. Included are data on the existing housing stock, designs for array mounting and system electrical wiring, and economic analyses for retrofits. DOE

**N83-12567#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**ROSET: A SOLAR-THERMAL ELECTRIC-POWER SIMULATION USERS GUIDE**
R. ODOHERTY Aug. 1982 78 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-021997; SERI/TR-214-1449) Avail: NTIS HC A05/MF A01

The use of a set of computer programs (ROSET) that simulate solar thermal electric poer systems is outlined. The ROSET is designed to function as part of a larger package of computer models. These models can be used with most utility planning models as part of a method for determining the value of solar energy power systems to electric utilities. DOE

**N83-12568#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**ELECTRICAL ASPECTS OF PHOTOVOLTAIC-SYSTEM SIMULATION**
G. W. HART and P. RAGHURAMAN Jun. 1982 22 p refs
(Contract DE-AC02-76ET-20279)
(DE82-021956; DOE/ET-20279/207) Avail: NTIS HC A02/MF A01

A TRNSYS simulation was developd to simulate the performance of utility interactive residential photovoltaic energy systems. The PV system is divided into major functional components, which are individually described with computer models. The results of simulation and actual measured data are compared. The electrical influences on the design of such photovoltaic energy systems are given particular attention GRA

**N83-12569#** Lincoln Lab, Mass. Inst. of Tech., Lexington
**DATA REPORT FOR THE NORTHEAST RESIDENTIAL EXPERIMENT STATION, APR. 1982**
M. C. RUSSELL, P. RAGHURAMAN, and P C. MAHONEY Jun. 1982 20 p refs
(Contract DE-AC02-76ET-20279)
(DE82-021954; DOE/ET-20279/214) Avail: NTIS HC A02/MF A01

Physical performance data obtained from photovoltaic energy systems under test at the Northeast Residential Experiment Station (NE RES) in Concord, Massachusetts, are tabulated for the month of April 1982. Five prototype residential photovoltaic systems are under test at the NE RES, each consisting of a roof mounted array sized to meet at least 50% of the annual electrical demand of an energy conserving house, and an enclosed structure to house the remainder of the photovoltaic system equipment, test instrumentation, and work space Each system is grid connected. In addition, one full sized PV residence, the Carlisle House, is also being monitored in Carlisle, Massachusetts The features of the systems and of the houses, are briefly summarized, and the monthly performance of the monitored houses, PV systems, and meteorological data is tabulated. Also tabulated is hourly information for an average day of the month including data on the monitored houses and prototype systems data. Data include energy consumption, array and inverter outputs, energy supplied to and by the utility, solar array panel temperatures, and total tilt insolation. Also included are tables that present the hypothetical energy exchange between the system and the utility if each prototype system supplied energy to each monitored house. These data are also graphed, as well as the duration of time for which the load had a specific value. DOE

**N83-12570#** Lincoln Lab., Mass. Inst. of Tech , Lexington. Field Tests and Applications Center
**PV MODULE DEGRADATION-ANALYSIS Final Report**
M. P. THEMELIS Jun. 1982 60 p refs
(Contract DE-AC02-76ET-20279)
(DE82-021123; DOE/ET-20279/189) Avail: NTIS HC A04/MF A01

The energy potential of photovoltaic (PV) components in various test applications were evaluated. Visual and electrical degradation analyses were performed on 47 PV modules. Discoloration, cracking, scratches, and electrical degradation were detected. DOE

**N83-12574#** Automation Industries, Inc , Silver Spring, Md Vitro Labs. Div.
**WILLIAMSON HOME, IPSWICH, MASS. SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, NOV. 1981 - APR. 1982**
M. CRAMER 1982 82 p refs
(Contract DE-AC01-79CS-30027)
(DE82-021300; SOLAR/1115-82/14) Avail: NTIS HC A05/MF A01

Data on solar water and space heating systems are given. The Williamson Home in Massachusetts is a single family residence whose active-solar-energy system is designed to supply 47% of the space heating and 91% of the hot water The system is equipped with 339 square feet of flat plate collectors, a 240-cubic-foot rock bin for storage, a propane-gas furnace and a 100-gallon propane gas hot water tank for auxiliary heating. Monthly performance data are tabulated for the overall system and for the collector, hot water, and space heating subsystems Also tabulated are solar coefficients of performance, solar operating energy, energy savings, and weather conditions. Also given is a graph of collector array efficiency versus the difference between the inlet water and ambient temperatures divided by insolation. System operation is illustrated by graphs of typical insolation data and outside ambient and indoor temperatures, collector operating periods and inlet/outlet temperatures, and typical storage and distribution temperatures versus time for a typical day. The system operating sequence and solar energy utilization and losses are also graphed. GRA

**N83-12575#** Automation Industries, Inc , Silver Spring, Md. Vitro Labs. Div.
**LO-CAL, CHAMPAIGN, ILLINOIS SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, JAN. 1982 - APR. 1982**
J. W. SPEARS 1982 73 p refs
(Contract DE-AC01-79CS-30027)
(DE82-021299; SOLAR/1109-82/14) Avail: NTIS HC A04/MF A01

Performance data on a solar heated house are given. The Lo-Cal site is a single family residence in Illinois with a direct gain solar heating system equipped with 200 square feet of south facing triple glazed windows and an auxiliary 84,000 Btu hour forced air furnace For the months of January through April 1982, the solar fraction was found to be 29%, corresponding to a saving of 3107 kWh of conventional fuel. Monthly performance data are tabulated for the overall system, and for the collector and space heating subsystems. Also tabulated are monthly energy savings, weather, and passive system environment data The building's performance is illustrated by graphs for each month of the daily insolation, auxiliary heat, building temperature, and ambient temperature. DOE

**N83-12576#** Automation Industries, Inc , Silver Spring, Md Vitro Labs. Div.
**ISAKSON HOME, ANOKA, MINNESOTA SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, AUG. 1981 - MAR. 1982**
M. CRAMER 1982 77 p refs
(Contract DE-AC01-79CS-30027)
(DE82-021297; SOLAR/1116-82/14) Avail: NTIS HC A05/MF A01

Performance data on a residential solar water and space heating system are given. The Isakson Home in Minnesota is a single family residence whose active solar energy system is designed to supply 76% of the heating and hot water load. The system consists of 183 square feet of flat plate collectors, a 350 gallon water storage tank, and for back up, an oil fired furnace and 52 gallon electric water heater. Monthly performance data are given for the overall system and for the collector, domestic hot water, and space heating subsystem. Monthly data are also tabulated for the coefficient of performance, solar operating energy, energy savings, and weather. Typical system operation is illustrated by graphs of temperatures at various parts of the system versus time for a typical day, and by graphs of fuel use and hot water use versus time. The system operating sequence is also graphed and solar energy utilization and losses are given. DOE

**N83-12577#** Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
**KARASEK HOME, BLACKSTONE, MASSACHUSETTS SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, NOV. 1981 - MAR. 1982**
M. RAYMOND 1982 89 p refs
(Contract DE-AC01-79CS-30027)
(DE82-021302; SOLAR/1120-82/14) Avail: NTIS HC A05/MF A01

The Karasek Home is a single family Massachusetts residence whose active-solar-energy system is equipped with 640 square feet of trickle-down liquid flat-plate collectors, storage in a 300-gallon tank and a 2000-gallon tank embedded in a rock bin in the basement, and an oil-fired glass-lined 40-gallon domestic hot water tank for auxiliary water and space heating. Monthly performance data are tabulated for the overall system and for the collector, storage, space heating, and domestic hot water subsystems. For each month a graph is presented of collector array efficiency versus the difference between the inlet water temperature and ambient temperature divided by insolation. Typical system operation is illustrated by graphs of insolation and temperatures at different parts of the system versus time for a typical day. The typical system operating sequence for a day is also graphed as well as solar energy utilization and heat losses. DOE

**N83-12585#** Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
**TELLURIDE SCHOOL, TELLURIDE, COLORADO SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, FEBRUARY 1982 - APRIL 1982**
K. M. WELCH 1982 80 p refs
(Contract DE-AC01-79CS-30027)
Avail: NTIS HC A05/MF A01

In Colorado with a passive/active hybrid solar energy system designed to supply 40% of the heating load is discussed. The school is equipped with a 1428 square foot, double glazed Trombe wall, a 1392 square foot greenhouse with collection tube, and an auxiliary oil fired boiler. Monthly performance data are tabulated for the overall system and for the Trombe wall, greenhouse, and greenhouse storage. System operation is illustrated by graphs of typical Trombe wall insolation and temperatures and typical greenhouse insolation and temperatures. DOE

**N83-12586#** Automation Industries, Inc., Silver Spring, Md. Vitro Labs. Div.
**WOOD ROAD SCHOOL, BALLSTON SPA, NEW YORK SOLAR-ENERGY-SYSTEM PERFORMANCE EVALUATION, NOVEMBER 1981 - APRIL 1982**
P. W. KENDALL 1982 86 p refs
(DE82-021301; SOLAR/2125-82/14) Avail: NTIS HC A05/MF A01

The Wood Road School Solar Project is a 216,000 square foot (136,510 square feet of sola conditioned space) school located in New York. The solar energy system supplies 64% of the space heating and 88% of the hot water. The system is equipped with 15,389 square feet of one type of flat plate collector panels and 6650 square feet of another type Storage is in two 15,000 gallon storage tanks, and auxiliary heating is by electric resistance strip heaters. Monthly performance data are tabulated for the overall system and for each type of collector, storage, domestic hot water, and space heating subsystems. Weather conditions energy savings, operating energy, and coefficients of performane are tabulated monthly. Graphs are provided of collector array efficiency vs the difference between the fluid inlet temperature and ambient temperature divided by insolation. System operation is illustrated by graphs of collector array inlet/outlet temperatures and ambient temperature and typical building loop temperatures vs time for a typical day. The system operating sequence and the solar energy utilization and energy losses are graphed. DOE

**N83-12587#** Midwest Research Inst., Golden, Colo. Component Development and Fabrication Group.
**STRUCTURAL DESIGN CONSIDERATIONS FOR A LINE-FOCUS REFLECTIVE MODULE USING INEXPENSIVE COMPOSITE MATERIALS**
L. M. MURPHY Aug. 1982 59 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-021611; SERI/TR-253-1450) Avail: NTIS HC A04/MF A01

The structural design aspects of a parabolic trough reflective module is addressed. The reflective module is a lightweight, low flexural rigidity design that is rotated about the focal line. The modules and support frame are designed to rotate with a cable drive system in a cross row manner. Analysis indicates that the structural and optical aspects of the reflector frame concept are adequate, with dramatic savings in weight and costs for the structure. DOE

**N83-12588#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**SCATTERPLATE FLUX MAPPING FOR SOLAR CONCENTRATORS**
K. MASTERSON and M. BOHN Sep. 1982 17 p refs Presented at the Ann. Meeting of the Optical Soc. of Am., Chicago, 13-17 Oct. 1981
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-021359; SERI/TR-255-1432) Avail: NTIS HC A02/MF A01

Developing the ability to characterize accurately the spatial distribution of solar energy at the receiver is a part of advanced solar thermal conversion technology. High power levels near the focus of a point focus concentrator make this difficult because of the large thermal stress placed on materials and components. A scatterplate flux mapping technique developed at the Solar Energy Research Institute (SERI) that solves many material problems and the optical characteristics of several scatterplate materials are described. The errors contributed by a scatterplate with nonideal characteristics typical of the materials used are assessed. DOE

**N83-12589#** National Bureau of Standards, Washington, D.C.
**COMPARATIVE ANALYSIS OF ECONOMIC MODELS IN SELECTED SOLAR ENERGY COMPUTER PROGRAMS Final Report**
J. W. POWELL and K. A. BARNES Jan. 1982 83 p refs Sponsored by DOE
(PB82-184995; NBSIR-81-2379) Avail: NTIS HC A05/MF A01 CSCL 10A

The economic evaluation models in five computer programs widely used for analyzing solar energy systems (F-CHART 3.0, F-CHART 4.0, SOLCOST, BLAST, and DOE-2) are compared. Differences in analysis techniques and assumptions among the programs are assessed from the point of view of consistency with the Federal requirements for life cycle costing (10 CFR Part 436), effect on predicted economic performance, and optimal system size, case of use, and general applicability to diverse systems types and building types. The FEDSOL program developed by the National Bureau of Standards specifically to meet the Federal life cycle cost requirements serves as a basis for the comparison. Results of the study are illustrated in test cases of two different types of Federally owned buildings: a single family residence and a low rise office building. A.R.H.

**N83-13504#** Sandia Labs., Albuquerque, N. Mex.
**CONTACT STRESSES ON A THIN PLATE AFTER LARGE DISPLACEMENTS TO A FULL PARABOLIC SURFACE**
R. C. REUTER, JR. and R K. WILSON Dec. 1981 26 p refs (Contract DE-AC04-76DP-00789)
(DE82-005712; SAND-81-2083) Avail. NTIS HC A03/MF A01

A solution is obtained for the determination of all loads necessary to hold an initially flat, thin, elastic plate in the shape of a prescribed parabolic surface, following large displacement. These loads include spatially varying normal tractions distributed over the back surface of the plate, and a uniform shear force and bending moment applied along the opposing edges which become the rims of the parabola after deformation. The plate represents a reflective surface which is mechanically deformed to the shape of, and bonded to a rigid, parabolic substructure to create a solar collector. After assembly, the normal stresses are those developed in the adhesive which bonds the reflective surface to the substructure. The absence of edge loads along the rims of an actual, formed reflective surface gives rise to local displacement and stress variations (edge effects) which are obtained through a separate solution. Numerical results for the normal stress distribution, local variations and loss of optical quality in the edge effect zone are included. DOE

**N83-13579*** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**SOLAR CELL HAVING IMPROVED BACK SURFACE REFLECTOR Patent**
A. T. CHAI, inventor (to NASA) 19 Oct. 1982 5 p Filed 11 Mar. 1981
(NASA-CASE-LEW-13620-1; US-PATENT-4,335,196;
US-PATENT-APPL-SN-242796; US-PATENT-CLASS-136-259;
US-PATENT-CLASS-29-572; US-PATENT-CLASS-136-256;
US-PATENT-CLASS-357-30; US-PATENT-CLASS-427-88;
US-PATENT-CLASS-427-89; US-PATENT-CLASS-427-90;
US-PATENT-CLASS-427-91) Avail: US Patent and Trademark Office CSCL 10A

The operating temperature is reduced and the output of a solar cell is increased by using a solar cell which carries electrodes in a grid finger pattern on its back surface. These electrodes are sintered at the proper temperature to provide good ohmic contact. After sintering, a reflective material is deposited on the back surface by vacuum evaporation. Thus, the application of the back surface reflector is separate from the back contact formation. Back surface reflectors formed in conjunction with separate grid finger configuration back contacts are more effective than those formed by full back metallization of the reflector material.
Official Gazette of the U.S. Patent and Trademark Office

**N83-13580** Utah State Univ., Logan.
**A COMPUTER SIMULATION MODEL OF SALT-GRADIENT SOLAR PONDS Ph.D. Thesis**
Z. PANAHI 1982 196 p
Avail: Univ. Microfilms Order No. DA8224162

The mass and energy transfer processes of a salt gradient solar pond were developed into a finite element of computer model. The system represented by the model can be: (1) a nonconvective salt gradient solar pond for which the energy transfer takes place by conduction through the brine and the ground beneath the pond; (2) a stratified three zone solar pond consisting of upper and lower convective zones and a nonconvective gradient zone in between. The temperature of the upper and lower convective zones are predicted in terms of the net energy input to the zones. The energy fluxes at the pond surface include: reflected and absorbed solar radiation, evaporation energy loss, net long wave radiation loss to the atmosphere, advacted energy of precipitation and inflow water, and convective heat loss at the surface. Dissert. Abstr.

**N83-13581*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SOLAR THERMAL TECHNOLOGY REPORT, FY 1981. VOLUME 1: EXECUTIVE SUMMARY Annual Technical Progress Report**
Jun. 1982 11 p refs Sponsored in part by NASA 2 Vol.
(Contract DE-AI01-79ET-20307; DE-AM04-80AL-13137)
(NASA-CR-169526; JPL-PUB-82-60-VOL-2;
DOE/JPL-1060-53-VOL-2; NAS 1.26:169526) Avail. NTIS HC A02/MF A01 CSCL 10A

The activities of the Department of Energy's Solar Thermal Technology Program are discussed. Highlights of technical activities and brief descriptions of each technology are given. Solar thermal conversion concepts are discussed in detail, particularly concentrating collectors and salt-gradient solar ponds. R.J.F.

**N83-13582*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SOLAR THERMAL TECHNOLOGY REPORT, FY 1981. VOLUME 2: TECHNICAL Annual Technical Progress Report**
Jun. 1982 113 p refs Sponsored in part by NASA 2 Vol.
(Contract DE-AI01-79ET-20307; DE-AM04-80AL-13137)
(NASA-CR-169527; JPL-PUB-82-60-VOL-1;
DOE/JPL-1060-53-VOL-1; NAS 1.26:169527) Avail: NTIS HC A06/MF A01 CSCL 10A

Detailed descriptions of the Department of Energy's Solar Thermal Technology Program projects and activities are given. A bibliography on solar energy conversion is included. R J.F.

**N83-13583*#** Jet Propulsion Lab., California Inst. of Tech, Pasadena.
**PRICE ESTIMATES FOR THE PRODUCTION OF WAFERS FROM SILICON INGOTS**
A. R. MOKASHI 15 Sep. 1982 30 p refs
(Contract DE-AI01-76ET-20356)
(NASA-CR-169517; DOE/JPL-1012-74; JPL-5101-212;
JPL-PUB-82-65; NAS 1.26:169517) Avail: NTIS HC A03/MF A01 CSCL 10A

The status of the inside-diameter sawing, (ID), multiblade sawing (MBS), and fixed-abrasive slicing technique (FAST) processes are discussed with respect to the estimated price each process adds on to the price of the final photovoltaic module. The expected improvements in each process, based on the knowledge of the current level of technology, are projected for the next two to five years and the expected add-on prices in 1983 and 1986 are estimated. M.G.

**N83-13585*#** ••rse Soviet energy production will take if present policies in the West and the USSR remain unchanged is investigated.••Opportu

**MARKET ASSESSMENT OF PHOTOVOLTAIC POWER SYSTEMS FOR AGRICULTURAL APPLICATIONS WORLDWIDE Final Report**

A CABRAAL, D. DELASANTA, J. ROSEN, J. NOLFI (ARD, Inc.), and R. ULMER (ARD, Inc.) Nov. 1981 89 p refs
(Contract DEN3-180; DE-AI01-79ET-20485)
(NASA-CR-165541; DOE/NASA/0180-6; NAS 1.26:165541)
Avail: NTIS HC A05/MF A01 CSCL 10B

Agricultural sector PV market assessments conducted in the Phillippines, Nigeria, Mexico, Morocco, and Colombia are extrapolated worldwide. The types of applications evaluated are those requiring less than 15 kW of power and operate in a stand alone mode. The major conclusions were as follows: PV will be competitive in applications requiring 2 to 3 kW of power prior to 1983; by 1986 PV system competitiveness will extend to applications requiring 4 to 6 kW of power, due to capital constraints, the private sector market may be restricted to applications requiring less than about 2 kW of power; the ultimate purchase of larger systems will be governments, either through direct purchase or loans from development banks. Though fragmented, a significant agriculture sector market for PV exists; however, the market for PV in telecommunications, signalling, rural services, and TV will be larger Major market related factors influencing the potential for U.S. PV Sales are· lack of awareness; high first costs; shortage of long term capital, competition from German, French and Japanese companies who have government support; and low fuel prices in capital surplus countries. Strategies that may aid in overcoming some of these problems are. setting up of a trade association aimed at overcoming problems due to lack of awareness, innovative financing schemes such as lease arrangements, and designing products to match current user needs as opposed to attempting to change consumer behavior. Author

**N83-13586*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**SUMMARY OF FLAT-PLATE SOLAR ARRAY PROJECT DOCUMENTATION. ABSTRACTS OF PUBLISHED DOCUMENTS, 1975 TO JUNE 1982**

15 Sep. 1982 372 p Sponsored in part by DOE
(NASA-CR-169518; JPL-PUBL-82-79; DOE/JPL-1012-76; JPL-5101-221, NAS 1.26:169518) Avail· NTIS HC A16/MF A01 CSCL 10A

Technologies that will enable the private sector to manufacture and widely use photovoltaic systems for the generation of electricity in residential, commercial, industrial, and government applications at a cost per watt that is competitive with other means is investigated. Silicon refinement processes, advanced silicon sheet growth techniques, solar cell development, encapsulation, automated fabrication process technology, advanced module/array design, and module/array test and evaluation techniques are developed. S.L

**N83-13596#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

**PERFORMANCE CRITERIA FOR PHOTOVOLTAIC ENERGY SYSTEMS, VOLUME 1**

G. NUSS, R. DEBLASIO, S. FORMAN, A. HOFFMAN, S HOGAN, P. LONGRIGG, H. POST, R ROSS, and H. SCHAFFT Jul. 1982 179 p 2 Vol.
(Contract DE-AC02-77CH-00178)
(DE82-021958, SERI/TR-214-1567-VOL-1) Avail: NTIS HC A09/MF A01

The state of the art in defining performance criteria for photovoltaic (PV) systems and their components the PV array, power conditioning, monitor and control, and storage subsystems, cabling, and power distribution is presented. Each performance criterion consists of a criterion statement, an evaluation statement and a commentary statement. Performance criteria deal with: electrical, thermal, mechanical/structural, safety, durability/reliability, installation, operation and maintenance, and building and site characteristics. The performance criteria are not prescriptive; they are performance oriented to allow for innovation and for a variety of approaches to obtain desired objectives for a PV system or subsystem. A glossary is presented with definitions relevant to photovoltaic subsystems. DOE

**N83-13597#** Midwest Research Inst , Golden, Colo. Solar Energy Research Inst.

**PERFORMANCE CRITERIA FOR PHOTOVOLTAIC ENERGY SYSTEMS, VOLUME 2**

G. NUSS, R. DEBLASIO, S. FORMAN, A HOFFMAN, S. HOGAN, P. LONGRIGG, H. POST, R. ROSS, and H. SCHAFFT Jul 1982 242 p refs 2 Vol.
(Contract DE-AC02-77CH-00178)
(DE82-021683; SERI/TR-214-1567-VOL-2) Avail: NTIS HC A11/MF A01

A unified body of test procedures for the evaluation of photovoltaic subsystem performance criteria was established. The test methods represent recommended evaluation procedures, but they are not consensus standards tests. The tests address electrical, thermal, mechanial, and durability aspects of the solar cell array, and the electrical aspects of the power conditioning subsystem and battery storage subsystem. DOE

**N83-13599#** Sandia Labs., Albuquerque, N. Mex.

**INTERMEDIATE PHOTOVOLTAIC SYSTEM APPLICATION EXPERIMENT OPERATIONAL PERFORMANCE REPORT FOR CDC LIGHT MANUFACTURING BUILDING, SAN BERNARDINO, CALIFORNIA**

Aug 1982 25 p Prepared in cooperation with Boeing Computer Services Co.
(Contract DE-AC04-76DP-00789)
(DE82-020883; SAND-81-7089/3) Avail. NTIS HC A02/MF A01

The data accumulated during May at the intermediate photovoltaic project at the CDC Light Manufacturing Bldg., San Bernardino, California are presented. Generated energy and environmental (weather) data are presented graphically. Explanations of irregularities which are not attributable to weather are provided. DOE

**N83-13600#** California Univ., Berkeley. Lawrence Berkeley Lab

**ELECTROCHEMICAL STORAGE CELL BASED ON POLYCRYSTALLINE SILICON Final Report, 1 Mar. 1981 - 1 Mar. 1982**

D. CANFIELD and S. R MORRISON 28 Feb. 1982 56 p refs
(Contract DE-AC03-76SF-00098)
(DE82-020595, LBL-14639) Avail· NTIS HC A04/MF A01

Theoretical and experimental investigations on the performance of n and p type silicon in solution for efficient solar energy conversion were conducted. Part of the work sought to identify redox couples capable of inducing maximum band bending (highest open circuit voltage) and limit the corrosion for both n and p type silicon. High photovoltages were obtained by using vanadium (II/III) and ferrocene/ferricinium couples for p type and n type silicon respectively. These couples demonstrated reasonable stability, but their efficiency was limited by the growth of a relatively thick insulating SiO2 corrosion layer. Corrosion studies were performed to evaluate the use of HF to remove the corrosion layer and to consider the interaction between HF and the redox couple. Much of the experimental and theoretical work focused on the effect of the surface oxide on solar cell characteristics and led to a variety of surface treatments aimed at improving the fill factor of silicon photoelectrochemical cells. The surface treatments included high temperature annealing of the normal oxide under an argon or hydrogen atmosphere, coating a p n junction with a thin layer of platinum, and passivation with poly-vinylcarbazole polymer. DOE

**N83-13603#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**AN OVERVIEW OF SOLAR INDUSTRIAL PROCESS-HEAT (SIPH) APPLICATIONS BELOW 120 DEG C**
F. KREITH and R DAVENPORT Nov. 1981 37 p refs
(Contract DE-AC02-77CH-00178)
(DE82-021360; SERI/TR-252-1438) Avail. NTIS HC A03/MF A01

An overview of solar industrial process heat (SIPH) technologies and economics for applications below 1200 C is given and a procedure for optimally matching solar systems to industrial energy requirements is outlined. Cost and system performance of operational SIPH installations are summarized, and steps required to reduce the cost of the energy delivered by future SIPH systems are presented. DOE

**N83-13604#** Sandia Labs., Livermore, Calif.
**SOLAR COGENERATION**
*Apr. 1982 20 p refs*
(Contract DE-AC04-76D-00789)
(DE82-019085; DOE/NBM-2019085) Avail: NTIS HC A02/MF A01

After a brief introduction to the operational principles and advantages of solar cogeneration, seven cogeneration studies are summarized covering such applications as sulfur mining, copper smelting, enhanced oil recovery, natural gas processing, sugar mill operations, and space heating and cooling. For each plant is given a brief site description, project summary, conceptual design, and functional description, including a picture of the facility and a flow chart. Also listed are the addresses of the companies involved for obtaining additional information. DOE

**N83-13615#** Trinity Univ., San Antonio, Tex.
**DEVELOPMENT OF THE TRICKLE ROOF COOLING AND HEATING SYSTEM: EXPERIMENTAL PLAN**
P. HAVES, T JANKOVIC, and E. DODERER *Jul 1982 62 p* refs
(Contract DE-AC03-79CS-30201)
(DE82-019082, DOE/CS-30201-T9) Avail: NTIS HC A04/MF A01

A passive system applicable both to retrofit and new construction was developed. This system (the trickle roof system) dissipates heat from a thin film of water flowing over the roof. A small scale trickle roof system dissipator was tested at Trinity University under a range of ambient conditions and operating configurations. The results suggest that trickle roof systems should have comparable performance to roof pond systems. Provided is a review of the trickle roof system concept, several possible configurations, and the benefits the systems can provide. Test module experiments And results are presented in detail. The requirements for full scale testing are discussed and a plan is outlined using the two identical residential scale passive test facility buildings at Trinity University, San Antonio, Texas. Full scale experimental results would be used to validate computer algorithms, provide system optimization, and produce a nationwide performance assessment and design guidelines. This would provide industry with the information necessary to determine the commerical potential of the trickle roof system. DOE

**N83-13616#** County of Orange, Santa Ana, Calif.
**ACCEPTANCE-TEST REPORT FOR EL TORO LIBRARY SOLAR HEATING AND COOLING DEMONSTRATION PROJECT (SHAC NO. 1501)**
30 Mar. 1982 92 p
(Contract DE-FC03-77CS-31501)
(DE82-019859; DOE/CS-31501-T1) Avail: NTIS HC A05/MF A01

The results from arious mode acceptance tests on the El Toro Library Solar Energy System, are presented. All the modes tested function as designed Collector array efficiencies are calculated at approximately 40%. Chiller COP is estimated at .50, with chiller loop flow rates approximately 85 to 90% of design flow. The acceptance test included visual inspection, preoperational testing and procedure verification, operational mode checkout, and performance testing. DOE

**N83-13622#** Bechtel Corp., San Francisco, Calif.
**PHOTOVOLTAIC BALANCE-OF-SYSTEM ASSESSMENT Final Report**
Jun. 1982 136 p *refs Sponsored by Electric Power Research* Inst.
(Contract EPRI PROJ. 1975-2)
(DE82-906429; EPRI-AP-2474) Avail: NTIS HC A07/MF A01

The balance-of-system (BOS) status is assessed for photovoltaic power systems. The BOS includes all subsystems and components, except cells and modules, needed for a fully functional power system. The objectives of the study include status assessment and installed cost estimation for BOS subsystems and components, and estimates of system operation and maintenance requirements. The assessment was carried out for representative central station, intermediate, and residential applications. Array types evaluated include. flat plate and Fresnel lens concentrator for the central station; ground- and roof-mounted flat plate, and Fresnel lens and north-south parabolic trough concentrators for intermediate applications; and integral and direct-mounted flat plate for residential applications. Active and passive cooling are considered for central station and intermediate applications. Battery energy storage is included as an option for intermediate and residential applications. Results of the study indicate that array structures and power conditioning subsystems are major BOS cost elements. DOE

**N83-13623#** Electric Power Research Inst., Palo Alto, Calif. Advanced Power Systems Div.
**ELECTRIC-UTILITY SOLAR-ENERGY ACTIVITIES: 1981 SURVEY**
E. BACCELLI and K. GORDON Jul. 1982 318 p
(DE82-905804; EPRI-AP-2516-SR) Avail· NTIS HC A14/MF A01

Presented are the results of a survey to determine the scope of electric participation in solar energy projects in the United States. Brief descriptions are given of 943 projects being conducted by 236 utility companies. An index of projects by category, a statistical summary, a list of participating utilities with information contacts and addresses, a list of utilities with projects organized by technology, a list of utilities organized by state, a list of available reports on utility-sponsored projects, and a list of projects having multiple utility participants are included. DOE

**N83-13626#** Toulouse Univ. (France).
**THE REDUCTION OF RADIATION DAMAGE IN SOLAR CELLS. A STUDY OF RADIATION DEFECTS IN SILICON, FIRST PHASE Final Report**
J. BERNARD (ONERA, Toulouse), D. BIELLE-DASPET (Centre d'Etude Spatiale des Rayonnements), J BOURGOIN (Paris Univ. VII), and L. C. MUNOZ (Gorge Girona Salgado SN) Paris ESA Jun. 1981 100 p refs
(Contract ESTEC-4510/80/NL-JS(SC))
(CESR-81-985; ESA-CR(P)-1617) Avail: NTIS HC A05/MF A01

Research on space environmental flux and simulation of spatial conditions, defects induced by electron and proton radiation, and photon effects, in n and p-type silicon, microscopic and macroscopic measurement techniques for the study of defect properties and lifetime degradation in silicon solar cells, and numerical models for space solar cell and degradation prediction was surveyed. Long term prediction of solar generator degradation is limited by an insufficient knowledge of the degradation mechanisms of the solar cells in space. In space, p-type silicon behaves better than n-type. Lithium introduction in n-type silicon gives improvement only in particular structures. The role that lithium plays is difficult to identify and the time stability of lithium doped cells is uncertain. The major effects of photon degradation appear to be related to the presence of boron when the oxygen and carbon contents of the material are simulatenously low.
Author (ESA)

**N83-13632#** National Bureau of Standards, Washington, D.C. Building Equipment Div.
**A COMPARISON OF UNGLAZED FLAT PLATE LIQUID SOLAR COLLECTOR THERMAL PERFORMANCE USING THE ASHRAE STANDARD 96-1980 AND MODIFIED BSE TEST PROCEDURES**
J. P. JENKINS and K. A. REED May 1982 36 p refs Sponsored in part by DOE
(PB82-237660; NBSIR-82-2522) Avail: NTIS HC A03/MF A01 CSCL 10A

The report reviews the BSE procedure and summarizes the ASHRAE Standard 96-1980 for testing unglazed solar collectors The ASHRAE procedure consists exclusively of outdoor testing, whereas the BSE procedure requires a combination of outdoor and indoor testing (no irradiation) to determine the collector optical and thermal loss characteristics, respectively. Two unglazed flat plate liquid solar collectors were tested according to ASHRAE Standard 96-1980 and BSE procedures and the results compared During the indoor BSE thermal loss tests blowers were used to simulate winds of 0-3.9 m/s(0-8.72 mi/hr) to investigate the wind effect upon collector thermal losses. Author (GRA)

**N83-13672#** Weston (Roy F.), Inc., West Chester, Pa.
**TECHNOLOGY ASSESSMENT OF SOLAR THERMAL ENERGY APPLICATIONS IN WASTEWATER TREATMENT Final Report, May 1980 - Aug. 1981**
Feb. 1982 112 p refs
(Contract EPA-68-03-2775)
(PB82-229790; EPA-600/2-82-006) Avail: NTIS HC A06/MF A01 CSCL 13B

Three major areas were identified for which solar thermal energy usage has potential applicability in publicly owned treatment works. These areas include space and domestic water heating, anaerobic digester heating, and sludge drying. A detailed analysis of solar heating of anaerobic digesters utilizing an active solar energy (flat-plate collector) system is given. A present worth cost-effectiveness analysis was performed whereby the present worth of the anaerobic digester gas conserved was compared to the present worth of the solar energy collection system Based on the analysis, solar-aided anaerobic digester heating proved uneconomical at all locations within the United States. A sensitivity analysis was performed to determine which variable had the greatest effect on the cost analysis. Variables considered included collector system price per unit area, annual operations and maintenance cost, fuel escalation cost factor, and percent solids in digester feed. The analysis indicated that the collector system cost was the most sensitive item. GRA

**N83-14179#** State Univ of New York, Buffalo. Dept of Chemistry.
**THERMODYNAMICS AND PHOTOELECTROCHEMICAL BEHAVIOR OF THE N-TI02 ELECTRODE IN FLUORIDE CONTAINING SOLUTIONS**
T. HEPEL, M. HEPEL, and R. A. OSTERYOUNG 1 Sep 1982 54 p refs
(Contract N00014-79-C-0682)
(AD-A119144; SUNYBUF/DC/TR-10) Avail: NTIS HC A04/MF A01 CSCL 07E

Diagrams of the stable and metastable electrochemical equilibria for the system Ti - HF - H20 at 25 C have been constructed. Increased solubility of titanium dioxide in fluoride containing solutions has been found to occur over a narrow range of solution pH near 3.2. On the basis of the thermodynamic diagrams, appropriate conditions for etching n-Ti02 semiconductor electrodes were chosen. The etching solutions prepared for the n-Ti02 semiconductor electrodes showed very good surface-cleansing properties. A photoetching process under anodic bias is recommended for the preparation of the n-Ti02 surface for the purpose of use in solar energy converters. The doping profile in the space-charge layer which forms during the photoetching treatment is more effective for splitting the electron-hole pair created in a working electrochemical solar cell. Photocurrent-voltage characteristics obtained for n-Ti02 electrodes in F-solutions do not fit the Butler-Gartner equation, since the Butler-Gartner equation does not correctly describe photoeffects on medium and heavily doped semiconductor electrodes From the chronovoltamperometric and coulometric study of the reactions taking place at electrode potentials negative of the flat-band potential, only the first step of the Ti02 reduction to lower oxides is reversible Author (GRA)

**N83-14665*#** Westinghouse Research and Development Center, Pittsburgh, Pa.
**LARGE-AREA SHEET TASK ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT Quarterly Report, 24 Oct. - 31 Dec. 1981**
C S DUNCAN, R. G. SEIDENSTICKER, J. P. MCHUGH, R. H. HOPKINS, D. MEIER, and J. SCHRUBEN 18 Jun. 1982 23 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955843)
(NASA-CR-169624, DOE/JPL-955843-82/5; NAS 1.26:169624)
Avail: NTIS HC A02/MF A01 CSCL 10A

The thermal stress model was used to generate the design of a low stress lid and shield configuration, which was fabricated and tested experimentally. In preliminary tests, the New Experimental Web Growth Facility performed as designed, producing web on the first run. These experiments suggested desirable design modifications in the melt level sensing system to improve further its performance, and these are being implemented. Author

**N83-14666*#** AiResearch Mfg. Co., Los Angeles, Calif.
**A HIGH TEMPERATURE CERAMIC HEAT EXCHANGER ELEMENT FOR A SOLAR THERMAL RECEIVER Final Report**
H. J. STRUMPF, D. M. KOTCHICK, and M. G COOMBS 23 Mar. 1982 114 p refs Prepared for JPL
(NASA-CR-169625, NAS 1.26:169625; REPT-81-18452) Avail: NTIS HC A06/MF A01 CSCL 10A

The development of a high-temperature ceramic heat exchanger element to be integrated into a solar receiver producing heated air was studied. A number of conceptual designs were developed for heat exchanger elements of differing configuration. These were evaluated with respect to thermal performance, pressure drop, structural integrity, and fabricability. The final design selection identified a finned ceramic shell as the most favorable concept. The shell is surrounded by a larger metallic shell. The flanges of the two shells are sealed to provide a leak-tight pressure vessel The ceramic shell is to be fabricated by a innovative combination of slip casting the receiver walls and precision casting the heat transfer finned plates The fins are bonded to the shell during firing. The unit is sized to produce 2150 F air at 2.7 atm pressure, with a pressure drop of about 2 percent of the inlet pressure. This size is compatible with a solar collector providing a receiver input of 85 kw(th). Fabrication of a one-half scale demonstrator ceramic receiver was completed. Author

**N83-14668*#** Solarelectronics, Inc., Bellingham, Mass.
**INVESTIGATION OF THE HYDROCHLORINATION OF SC4 Quarterly Report, 9 Jul. - 8 Oct. 1982**
J. Y. P. MUI 15 Oct. 1982 26 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-956061)
(NASA-CR-169621; DOE/JPL-956061-5; NAS 1.26:169621; QR-5)
Avail: NTIS HC A03/MF A01 CSCL 10A

The hyrochlorination of SiC14 and m.g. silicon metal to produce SiHC13, was investigated Reaction kinetic measurements were carried out to collect additional rate data at 525 C and 550 C. A theoretical study was carried out to provide a kinetic model and a rate equation for the hydrochlorination reaction. Results of this preliminary study show that the rate of formation of SiHC13 follows a pseudo first order kinetics. The rate constants were measured at three temperatures, 550 C, 500 C and 450 C, respectively. The activation energy was determined from the Arrhenius plot to give a value of 13.2 Kcal/mole. The design of a quartz reactor to measure reaction rates and equilibrium conversion of SiHC13 at reaction temperature up to 650 C was completed J.M.S.

**N83-14669*#** *Westinghouse Research and Development Center, Pittsburgh, Pa.*
**LARGE-AREA SHEET TASK ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT Quarterly Report, 1 Apr. - 30 Jun. 1982**
C. S. DUNCAN, R. G. SEIDENSTICKER, J. P. MCHUGH, R. H HOPKINS, D. MEIER, and J. SCHRUBEN 17 Sep. 1982 40 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955843)
(NASA-CR-169639; DOE/JPL-955843-82/7; NAS 1.26:169639)
Avail. NTIS HC A03/MF A01 CSCL 10A

The computer code for calculating web temperature distribution was expanded to provide a graphics output in addition to numerical and punch card output. The new code was used to examine various modifications of the J419 configuration and, on the basis of the results, a new growth geometry was designed. Additionally, several mathematically defined temperature profiles were evaluated for the effects of the free boundary (growth front) on the thermal stress generation. Experimental growth runs were made with modified J419 configurations to complement the modeling work. A modified J435 configuration was evaluated. Author

**N83-14670*#** Clemson Univ., S.C. Dept. of Electrical and Computer Engineering.
**INVESTIGATION OF RELIABILITY ATTRIBUTES AND ACCELERATED STRESS FACTORS ON TERRESTRIAL SOLAR CELLS Summary Report**
J. W. LATHROP Jun. 1982 91 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-954929)
(NASA-CR-169620; DOE/JPL-954929-82/9, NAS 1.26.169620)
Avail. NTIS HC A05/MF A01 CSCL 10A

The accelerated stress test results obtained on all terrestrial solar cells since the inception of the program are summarized. Tested cells were grouped according to the method used to form the conductive metallization layer: solder dipped, vacuum deposited, screen printed, and copper plated. Although metallization systems within each group were quite similar, they differed in numerous details according to the procedures employed by each manufacturer. Test results were summarized for all cells according to both electrical degradation and catastrophic mechanical changes. These results indicated a variability within each metallization category which was dependent on the manufacturer. Only one manufacturer was represented in the copper plated category and, although these showed no signs of detrimental copper diffusion during high temperature testing, their metallization was removed easily during high humidity pressure cooker testing Preliminary testing of encapsulated cells showed no major differences between encapsulated and unencapsulated cells when subjected to accelerated testing. Author

**N83-14671*#** Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
**LOW COST SOLAR ARRAY PROJECT CELL AND MODULE FORMATION RESEARCH AREA: PROCESS RESEARCH OF NON-CZ SILICON MATERIAL Quarterly Report, 1 Jun. - 31 Aug. 1982**
1981 33 p
(Contract JPL-955909)
(NASA-CR-169632; NAS 1.26:169632; DOE/JPL-955909-82-7; TME-3158; DRL-157; DRD-SE-2; QR-7) Avail: NTIS HC A03/MF A01 CSCL 10A

Liquid diffusion masks and liquid applied dopants to replace the CVD Silox masking and gaseous diffusion operations specified for forming junctions in the Westinghouse baseline process sequence for producing solar cells from dendritic web silicon were investigated. The baseline diffusion masking and drive processes were compared with those involving direct liquid applications to the dendritic web silicon strips. Attempts were made to control the number of variables by subjecting dendritic web strips cut from a single web crystal to both types of operations. Data generated reinforced earlier conclusions that efficiency levels at least as high as those achieved with the baseline back junction formation process can be achieved using liquid diffusion masks and liquid dopants. The deliveries of dendritic web sheet material and solar cells pecified by the current contract were made as scheduled. Author

**N83-14673*#** Hemlock Semiconductor Corp., Mich.
**DEVELOPMENT OF A POLYSILICON PROCESS BASED ON CHEMICAL VAPOR DEPOSITION, PHASE 1 Quarterly Progress Report, 1 Apr. - 30 Jun. 1981**
F. PLAHUTNIK, A. ARVIDSON, and D. SAWYER 5 May 1982 25 p refs
(Contract JPL-955533)
(NASA-CR-169633; NAS 1.26:169633; DOE/JPL-955533-81-7; QPR-7) Avail: NTIS HC A02/MF A01 CSCL 10A

The goal of this program is to demonstrate that a dichlorosilane-based reductive chemical vapor deposition (CVD) process is capable of producing, at low cost, high quality polycrystalline silicon. Physical form and purity of this material will be consistent with LSA material requirements for use in the manufacture of high efficiency solar cells. Four polysilicon deposition runs were completed in an intermediate size reactor using dichlorosilane fed from 250 pound cylinders. Results from the intermediate size reactor are consistent with those obtained earlier with a small experimental reactor. Modifications of two intermediate size reactors were completed to interface with the dichlorosilane process demonstration unit (PDU). B.W.

**N83-14674*#** Ross (Bernd) Associates, San Diego, Calif
**DEVELOPMENT OF AN ALL-METAL THICK FILM COST EFFECTIVE METALLIZATION SYSTEM FOR SOLAR CELLS Interim Report, May 1980 - Aug. 1981**
B. ROSS and J PARKER Jul. 1982 92 p refs Sponsored in part by DOE Prepared for JPL
(NASA-CR-169635; DOE/JPL-955688-81/5; NAS 1.26:169635; DRD-SE-6; REPT-9950-742) Avail: NTIS HC A05/MF A01 CSCL 10A

Electrodes made with pastes produced under the previous contract were analyzed and compared with raw materials. A needle-like structure observed on the electroded solar cell was identified as eutectic copper-silicon, a phase considered to benefit the electrical and metallurgical properties of the contact. Electrodes made from copper fluorocarbon and copper silver fluoride also contained this phase but had poor adhesion. A liquid medium, intended to provide transport during carbon fluoride decomposition was incorporated into the paste resulting in better adhesion The product survived preliminary environmental tests. A 2 cm by 2 cm solar cell made with fluorocarbon activated copper electrodes and gave 7% AMI efficiency (without AR coating). Both silver fluoride and fluorocarbon screened paste electrodes can be produced for approximately $0.04 per watt. A R.H.

**N83-14675*#** Westinghouse Research and Development Center, Pittsburgh, Pa.
**LARGE-AREA SHEET TASK ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT Quarterly Report, 1 Jan. - 31 Mar. 1982**
C. S. DUNCAN, R. G. SEIDENSTICKER, J. P. MCHUGH, R. H. HOPKINS, D. MEIER, and J. SCHRUBEN 18 Aug. 1982 28 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955843)
(NASA-CR-169637; DOE/JPL-955843-82/6; NAS 1.26:169637)
Avail: NTIS HC A03/MF A01 CSCL 10A

The 'discrete shield' temperature model was completed and verified. Modifications to the J419 low stress configuration were tested experimentally to evaluate effects on growth speed. A composite lid and shield configuration combining the low stress features of the J419 with the width limiting characteristics of the J98M3 was fabricated and tested in the N-furnace. Several long crystals were grown with width limited to about 3.3 cm and with melt replenishment, although the configuration is not yet optimized for steady state growth. S.L.

**N83-14676*#** Springborn Labs., Inc., Enfield, Conn
**INVESTIGATION OF TEST METHODS, MATERIAL PROPERTIES AND PROCESSES FOR SOLAR CELL ENCAPSULANTS**
P. B. WILLIS and B. BAUM Jul. 1982 145 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-954527; JPL PROJ. 6072.1)
(NASA-CR-169636; DOE/JPL-954527-82; NAS 1.26:169636; REPT-9950-744) Avail: NTIS HC A07/MF A01 CSCL 10A

The evaluation of potentially useful low cost encapsulation materials is discussed. The goal is to identify, evaluate, test and recommend encapsulant materials and processes for the production of cost effective, long life solar cell modules. Technical investigations concerned the development of advanced cure chemistries for lamination type pottants; the continued evaluation of soil resistant surface treatment, and the results of an accelerated aging test program for the comparison of material stabilities. New compounds were evaluated for efficiency in curing both ethylene/vinyl acetate and ethylene/methyl acrylate pottants intended for vacuum bag lamination of solar cells Two component aliphatic urethane casting syrups were evaluated for suitability as solar module pottants on the basis of optical, physical and fabrication characteristics. R.J.F.

**N83-14677*#** Mobil Tyco Solar Energy Corp., Waltham, Mass
**STRESS STUDIES IN EPG Quarterly Progress Report, 9 Jul. - 30 Sep. 1982**
15 Oct 1982 17 p refs Sponsored in part by DOE
(Contract JPL-956312)
(NASA-CR-169640; DOE/JPL-956312-82/01; NAS 1 26.169640)
Avail: NTIS HC A02/MF A01 CSCL 10A

A program to study stress generation mechanisms in silicon sheet growth was started. The purpose of the research is to define post-growth temperature profiles for the sheet that can minimize its stress during growth at high speeds, e g , greater than 3 cm/min The initial tasks described concern work in progress toward the development of computing capabilities to (1) model stress-temperature relationships in steady-state ribbon growth, and (2) provide a means to calculate realistic temperature fields in ribbon, given growth system component temperatures as boundary conditions. If it is determined that low stress configurations can be achieved, the modeling is to be tested experimentally by constructing low-stress growth systems for EFG silicon ribbon
Author

**N83-14678*#** Ford Aerospace and Communications Corp., Palo Alto, Calif. Antenna Engineering Dept
**FEASIBILITY STUDY OF SOLID SURFACE SUBREFLECTOR PRODUCTION TECHNIQUES Final Report**
15 May 1982 25 p refs Prepared for JPL
(Contract NAS7-100; JPL-956137)
(NASA-CR-169642; NAS 1.26:169642; WDL-TR9598) Avail: NTIS HC A02/MF A01 CSCL 10A

The principal effort was to study technical feasibility and cost aspects of the production technique of spin forming a subreflector reflective surface to a desired surface of revolution, back the surface with fiberglass to stabilize it sufficiently so that it may be machined to the target surface tolerance of .008 inches Root Mean Square (RMS) with a goal of .003 inches RMS To verify this production technique, analyses was performed to define the production procedure. A price estimate for a 150 inch diameter subreflector for a 34 meter cassegrain antenna. During this feasibility study, numerous production processes were evaluated theoretically as production approaches for single surface, non-welded subreflectors. The first successful was the principal process of spin forming the reflective surface, backing with fiberglass and machining to a final contour. The second successful process was spin forming or bump forming a thicker reflective surface, with an integral (welded in) structure as a backing and machining the mounting pads and reflector to a final configuration. B.W.

**N83-14679*#** Photowatt International, Inc., Tempe, Ariz.
**DEVELOPMENT OF TECHNIQUE FOR AR COATING NICKEL AND COPPER METALLIZATION OF SOLAR CELLS FPS PROJECT PRODUCT DEVELOPMENT Quarterly Technical Report, 1 Apr. - 30 Jun. 1982**
W. TAYLOR 15 Jul. 1982 20 p refs Prepared for JPL
(Contract JPL-955986)
(NASA-CR-169616; DOE/JPL-955986-3; NAS 1.26:169616; QTR-4) Avail: NTIS HC A02/MF A01 CSCL 10A

Experimental matrices were conducted to determine a suitable firing schedule for fritless tin printing ink. considerable difficulties were encountered with oxidation. Best results were obtained with a firing cycle consisting of 400 C for 20 minutes in nitrogen followed by 5 minutes in air at 500 C. Elimination of oxidizing conditions impaired the adhesion of both tin and copper fritless printing inks, although adhesion of fritless copper inks was obtained when fired in nitrogen with slight oxidation. Author

**N83-14680*#** ••ental matrices were conducted to determine a suitable firing schedule for fritless tin printing ink. considerable difficulties
**ANALYSIS OF DEFECT STRUCTURE IN SILICON. CHARACTERIZATION OF SAMPLES FROM UCP INGOT 5848-13C Interim Report**
R. NATESH, T. GUYER, and G. B. STRINGFELLOW Aug. 1982 75 p refs
(Contract JPL-955676)
(NASA-CR-169617; DOE/JPL-955676-2, NAS 1.26:169617; MRI-290) Avail: NTIS HC A04/MF A01 CSCL 10A

Statistically significant quantitative structural imperfection measurements were made on samples from ubiquitous crystalline process (UCP) Ingot 5848 - 13 C. Important trends were noticed between the measured data, cell efficiency, and diffusion length Grain boundary substructure appears to have an important effect on the conversion efficiency of solar cells from Semix material. Quantitative microscopy measurements give statistically significant information compared to other microanalytical techniques. A surface preparation technique to obtain proper contrast of structural defects suitable for QTM analysis was perfected. S.L.

**N83-14681*#** Underwriters Labs., Inc., New York.
**DEVELOPMENT OF PHOTOVOLTAIC ARRAY AND MODULE SAFETY REQUIREMENTS Final Report**
Jun. 1982 155 p refs Sponsored in part by DOE Prepared for JPL
(Contract JPL-955392)
(NASA-CR-169641; DOE/JPL-955392-1; NAS 1.26:169641)
Avail: NTIS HC A08/MF A01 CSCL 10A

Safety requirements for photovoltaic module and panel designs and configurations likely to be used in residential, intermediate, and large-scale applications were identified and developed. The National Electrical Code and Building Codes were reviewed with respect to present provisions which may be considered to affect the design of photovoltaic modules. Limited testing, primarily in the roof fire resistance field was conducted. Additional studies and further investigations led to the development of a proposed standard for safety for flat-plate photovoltaic modules and panels. Additional work covered the initial investigation of conceptual approaches and temporary deployment, for concept verification purposes, of a differential dc ground-fault detection circuit suitable as a part of a photovoltaic array safety system. R.J.F.

**N83-14682*#** Solarelectronics, Inc., Bellingham, Mass.
**INVESTIGATION OF THE HYDROCHLORINATION OF SICL4 Quarterly Report, 9 Apr. - 8 Jul. 1982**
J. Y. P. MUI 12 Apr. 1982 38 p refs Sponsored in part by DOE Prepared for JPL
(Contract NAS7-100; JPL-956061)
(NASA-CR-169622; DOE/JPL-956061-4, NAS 1.26:169622; QR-4)
Avail: NTIS HC A03/MF A01 CSCL 10A

Reaction kinetic measurements on the hydrochlorination of SiCl4 and metallurgical grade (m.g.) silicon metal were made at a wide range of experimental variables. The effect of pressure on

the reaction rate was studied at 25 psig, 100 psig, 150 psig and 200 psig, respectively. Results of these experiments show a large pressure effect on the hydrochlorination reaction. As expected, higher pressures produce a higher equilibrium SiHC13 conversion, since the hydrochlorination reaction results in a net volume contraction as product SiHC1 is formed. However, the reaction rate, namely, the rate at which the hydrochlorination reaction reaches its equilibrium SiHC13 conversion, was found to be much faster at low pressures. Author

**N83-14685*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ADVANCED CZOCHRALSKI SILICON GROWTH TECHNOLOGY FOR PHOTOVOLTAIC MODULES**
T. DAUD and A. H. KACHARE 15 Sep. 1982 40 p refs Sponsored by NASA
(Contract DE-AI01-76ET-20356)
(NASA-CR-169661; DOE/JPL-1012-70; JPL-PUB-82-35; JPL-5101-207; NAS 1.26:169661) Avail: NTIS HC A03/MF A01 CSCL 10A

Several economic analyses had indicated that large-diameter, multiple ingot growth using a single crucible with melt replenishment would be required for Cz growth to be economically viable. Based on the results of these analyses, two liquid and two solid feed melt replenishment approaches were initiated. The sequential solid feed melt replenishment approach, which demonstrated elements of technical feasibility is described in detail in this paper. Growth results of multiple ingots (10-cm-diameter, totaling 100 kg; and 15-cm-diameter, totaling 150 kg weight per crucible) are presented. Solar cells were fabricated and analyzed to evaluate the effects of structure and chemical purities as a result of multiple growth The results indicate that, with semiconductor-grade silicon, feedstock impurity build-up does not seem to degrade cell performance. For polycrystalline cells, the average efficiencies are 15 to 25% lower than those of single crystalline cells. Concerns regarding single crystal yields, crucible quality and growth speed are indicated, and present status and future research thrusts are also discussed. Author

**N83-14686*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**DISTRIBUTED PHOTOVOLTAIC SYSTEMS: UTILITY INTERFACE ISSUES AND THEIR PRESENT STATUS. INTERMEDIATE/THREE-PHASE SYSTEMS**
R. L. DAS, J. W. KLEIN, and T. W. MACIE 15 Sep. 1982 106 p refs Sponsored by NASA and DOE Prepared for Sandia Labs, Albuquerque, N. Mex.
(NASA-CR-169664; JPL-PUB-82-63, NAS 1.26:169664) Avail. NTIS HC A06/MF A01 CSCL 10A

The interface issues between the intermediate-size Power Conditioning Subsystem (PCS) and the utility are considered. A literature review yielded facts about the status of identified issues. Author

**N83-14687*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SOLAR CELL RADIATION HANDBOOK**
H. Y. TADA (TRW, Inc., Cleveland), J. R. CARTER, JR. (TRW, Inc., Cleveland), B. E. ANSPAUGH, and R. G. DOWNING 1 Nov. 1982 403 p refs
(NASA-CR-169662; JPL-PUB-82-69; NAS 1.26:169662) Avail: NTIS HC A18/MF A01 CSCL 10A

The handbook to predict the degradation of solar cell electrical performance in any given space radiation environment is presented. Solar cell theory, cell manufacturing and how they are modeled mathematically are described. The interaction of energetic charged particles radiation with solar cells is discussed and the concept of 1 MeV equivalent electron fluence is introduced. The space radiation environment is described and methods of calculating equivalent fluences for the space environment are developed. A computer program was written to perform the equivalent fluence calculations and a FORTRAN listing of the program is included. Data detailing the degradation of solar cell electrical parameters as a function of 1 MeV electron fluence are presented. E.A.K.

**N83-14692*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**HEAT TRANSPARENT HIGH INTENSITY HIGH EFFICIENCY SOLAR CELL Patent**
J. C. EVANS, JR., inventor (to NASA) 15 May 1981 7 p Filed 15 May 1981 Supersedes N81-27598 (19 - 18, p 2506)
(NASA-CASE-LEW-12892-1; US-PATENT-4,360,701; US-PATENT-APPL-SN-264380; US-PATENT-CLASS-136-259; US-PATENT-CLASS-136-255; US-PATENT-CLASS-136-256)
Avail: US Patent and Trademark Office CSCL 10A

An improved solar cell design is described. A surface of each solar cell has a plurality of grooves. Each groove has a vertical face and a slanted face that is covered by a reflecting metal Light rays are reflected from the slanted face through the vertical face where they traverse a photovoltaic junction. As the light rays travel to the slanted face of an adjacent groove, they again traverse the junction. The underside of the reflecting coating directs the light rays toward the opposite surface of solar cell as they traverse the junction again. When the light rays travel through the solar cell and reach the saw toothed grooves on the under side, the process of reflection and repeatedly traversing the junction again takes place. The light rays ultimately emerge from the solar cell These solar cells are particularly useful at very high levels of insolation because the infrared or heat radiation passes through the cells without being appreciably absorbed to heat the cell.
Official Gazette of the U.S. Patent and Trademark Office

**N83-14694#** European Space Agency, Paris (France)
**PHOTOVOLTAIC GENERATORS IN SPACE**
W. R. BURKE, comp Jun. 1982 331 p refs Partly in ENGLISH and FRENCH Proc. of 3rd European Symp. Bath, England, 4-6 May 1982; sponsored in cooperation with UK Dept. of Industry and RAE
(ESA-SP-173; ISSN-0379-6566) Avail. NTIS HC A15/MF A01

Solar array design and testing were discussed Radiation damage, blankets, solar cells, and the status of NASA and ESA spacecraft solar energy development programs were considered.

**N83-14695*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE SWING TO CONCENTRATOR ARRAYS**
J. L. MILLER *In* ESA Photovoltaic Generators in Space p xix-xxiv Jun. 1982 refs
Avail. NTIS HC A15/MF A01 CSCL 10A

Objectives and progress in both low concentration ratio (6 to 10) and high concentration ratio ( 100) array developments are summarized. Problems encountered include: thermal control, maldistribution of concentrated sunlight, current busing, and optical surface degradation. The potential advantages over planar arrays are an order of magnitude reduction in per unit cost of power plus increased immunity to radiation damage. Author (ESA)

**N83-14696#** AEG-Telefunken, Wedel (West Germany).
**LOW EARTH ORBIT BLANKET TECHNOLOGIES FOR THE POWER RANGE OF 15-60 KW**
H. BEBERMEIER *In* ESA Photovoltaic Generators in Space p 3-7 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The development of a 3.2 x 50 m foldable solar array is discussed. The blanket skin has a homogeneous rear side wiring of copper. A very thin foil is bonded onto the rear side of the glass fiber reinforced Kapton, giving extremely high in-plane and out-of-plane stiffness of the array compared to present technology. Metallic foil is also used to reinforce the hinge cusp and foldline cusp. The bending stiffness over the width of the array is optimized by the height and shape of the cusp and its reinforcement. Silicon or embossed Kapton damping cross elements (padding) placed in the solar cell corner gap, come down onto the center of the adjacent cell during retraction. A 5 x 5 cm silicon cell with back surface is used. Author (ESA)

**N83-14697#** Royal Netherlands Aircraft Factories Fokker, Amsterdam.
**ADVANCED RIGID ARRAY**
D. MAWIRA *In* ESA Photovoltaic Generators in Space p 9-14 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The development of an advanced rigid solar array designed to provide powers from 2 to 6 kW for medium class communications satellites is described. For satellites with single axis Sun tracking solar arrays, a rigid structure is suitable. A 50/50 percentage weight proportion, using back surface reflector/back surface field 100 microns solar cells, is possible. No interference problems are expected for the electrical system design. Author (ESA)

**N83-14698#** AEG-Telefunken, Wedel (West Germany). Neue Technologien.
**MODULE TECHNIQUE OF 5 X 5 CM(2) SOLAR CELLS**
J. KOCH *In* ESA Photovoltaic Generators in Space p 17-21 Jun. 1982 refs Sponsored by Bundesministerium fuer Forschung und Technologie
Avail: NTIS HC A15/MF A01

Investigations of cover glass bonding, contact welding, interconnection design and solar cell laydown to substrates are summarized. The module technique for 5 x 5 cm cells is characterized by 100 micron thick space qualified cover glasses (microsheet and fused silica) and interconnectors with stress reliefs in an out of plane and an inplane configuration. Thermal cycle tests prove the applicability of 5 x 5 cm cell module techniques on solar arrays. Author (ESA)

**N83-14699*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**LARGE AREA LOW-COST SPACE SOLAR CELL DEVELOPMENT**
C. R. BARONA and J. L. CIONI (NASA. Johnson Space Center) *In* ESA Photovoltaic Generators in Space p 23-26 Jun. 1982 refs
Avail: NTIS HC A15/MF A01 CSCL 10A

A development program to produce 5.9 x 5.9 cm space quality silicon solar cells with a cost goal of 30 $/W is described. Cell types investigated include wraparound dielectric, mechanical wraparound and conventional contact configurations with combinations of 2 or 10 ohm/cm resistivity, back surface reflectors and/or fields, and diffused or ion implanted junctions. A single step process to cut cell and cover glass simultaneously is being developed. Results for cell and array tests are given. Large solar arrays that might use cells of this type are discussed.
Author (ESA)

**N83-14700#** ETSI Telecomunicacion, Barcelona (Spain)
**NONLINEAR ALGORITHMS APPLICATION TO IRRADIATED SOLAR CELL PARAMETERS EVALUATION**
J. CABESTANY and L. CASTANER *In* ESA Photovoltaic Generators in Space p 27-33 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

A method which calculates the parameters of solar cell equivalent circuits is presented. The method is based on the definition of an object function of the difference between the experimental I(V) curve and the model. The object function is found to be nonlinear, so algorithms have to be used to find a solution that optimizes this function. Least mean square and minimax both give good results. A method to find an initial solution, critical in the time calculations of the routine, is also described. The parameters of proton irradiated solar cells were calculated.
Author (ESA)

**N83-14701#** Katholieke Universiteit te Leuven (Belgium). Lab. ESAT.
**LIFT OFF: A VERY FINE FRONT METALLIZATION GEOMETRY TECHNIQUE FOR HIGH EFFICIENCY SOLAR CELLS**
J. NIJS, F. DHOORE, R. MERTENS, and R. VANOVERSTRAETEN *In* ESA Photovoltaic Generators in Space p 37-42 Jun. 1982 refs Sponsored by Belgium National Research and Development Program of Energy
(Contract EEC-153-77-9ESB)
Avail: NTIS HC A15/MF A01

A lift off technique for TiPdAg metallization is described. A photoresist pattern is used before evaporation of the metal. After the metal is evaporated, the photoresist is removed, lifting off the metal on top of it. Where the photoresist was already removed before metallization with developing, the metal remains on the wafer. There must be a discontinuity in the metal due to the photoresist pattern, so that the dissolvant can reach the resist itself or the steps in the photoresist pattern may only be covered with a very thin layer of metal when the technique is used in an ultrasonic medium. Fingers of 10 microns width and 3 microns thickness are obtained, resulting in an optimized trade-off between metal coverage and series resistance. Silicon solar cells with AM1 efficiencies 17% are obtained. Author (ESA)

**N83-14702#** Spectrolab, Inc., Sylmar, Calif.
**THIN CELL DEVELOPMENT AND TESTING**
J. FODOR and N. NEAL *In* ESA Photovoltaic Generators in Space p 43-50 Jun. 1982
Avail: NTIS HC A15/MF A01

Over 200 silicon cells, 62 microns thick, with average AMO efficiencies of 13.5% were used in the fabrication of 10 lightweight modules featuring flexible substrates, welded interconnects, and thin coverslides ( 100 microns). The ability of these five cells in series by three cells in parallel modules to survive the space environment was proven by subjecting modules to acoustic and thermal cycle testing typical of planned geosynchronous missions.
Author (ESA)

**N83-14703#** AEG-Telefunken, Heilbronn (West Germany)
**A FAMILY OF THIN HIGH EFFICIENCY SILICON SOLAR CELLS**
K. D. RASCH, K. ROY, K. H. TENTSCHER, and D. GRINGEL *In* ESA Photovoltaic Generators in Space p 51-56 Jun 1982 refs Sponsored by Bundesministerium fuer Forschung und Technologie
Avail: NTIS HC A15/MF A01

Ultrathin (50 micron) and thin (100 and 150 micron) silicon solar cells were produced. The matrix contains cells with back surface reflector (BSR) and back surface field (BSF). The beginning of life (BOL) electrical output and the cell performance after electron irradiation up to 1 MeV and post photon irradiation testing as a function of thickness and base material (1 ohm-cm float zone and 10 ohm-cm crucible grown (CG) boron doped silicon) are presented. The ultrathin BSFR cell is the only cell that shows the advantage of BSF beyond 1MeV. In respect to cost and yield, non-BSF cells with an optimized BSR in the range of 100 to 150 microns are attractive for high fluence level missions. Besides the thermal advantage, the BSR in conjunction with diffused BSF shows benefits after electron radiation due to the photovoltaic effects of BSR. The FZ cells show the lowest EOL power output as a result of photon induced degradation. Nevertheless, these cells can be as attractive as a high EOL open-circuit voltage device, if the problem of photon degradation can be solved. Author (ESA)

**N83-14704#** Thorn EMI, Hayes (England). Central Research Labs.
**ELECTROPHORETED CDS/CU2S SOLAR CELLS FOR SPACE APPLICATIONS**
E. W. WILLIAMS, D. J. GIBBONS, T. J. CUMBERBATCH, I D. MCINALLY, and M. CLAYBOURN *In* ESA *Photovoltaic Generators* in Space p 57-61 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

*Both CdS and Cu2S were deposited by a process which uses* ammonium sulphide instead of hydrogen sulphide. Cracking is a problem on films with a thickness above 1.5 microns. In space grain size problems should be eliminated as calculations show that particle sizes 0.5 microns can be used in the colloids compared to 0.02 microns for terrestial colloids. Another problem is oxygen inclusion at the anode due to the lack of buoyancy of the bubbles formed in the water/methanol mixtures. However, high methanol contents reduce bubble concentrations. These photovoltaic junctions could be easily prepared in a long life solar breeder spacecraft. Tests of annealing with a pulsed dye laser indicate that photovoltages of 400mV can be produced from copper dipped CdS films. Author (ESA)

**N83-14705*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**ON THE CAUSE OF THE FLAT-SPOT PHENOMENON OBSERVED IN SILICON SOLAR CELLS AT LOW TEMPERATURES AND LOW INTENSITIES**
V. G. WEIZER, J. D. BRODER, H. W. BRANDHORST, and A. F. FORESTIERI *In* ESA *Photovoltaic Generators in Space* p 65-70 Jun. 1982 refs
Avail: NTIS HC A15/MF A01 CSCL 10A

*A model that explains the flat-spot power loss phenomenon* is presented. Evidence suggests that the effect is due to localized metallurgical interactions between the silicon substrate and the contact metallization. These reactions are shown to result in localized regions in which the P-N junction is destroyed and replaced with a metal semiconductor-like interface. The effects of thermal treatment, crystallographic orientation, junction depth, and metallization are shown along with a method of preventing the effect through the suppression of vacancy formation at the free surface of the contact metallization Data indicating the effectiveness of a TiN diffusion barrier in preventing the effect are also given. Author (ESA)

**N83-14706#** AEG-Telefunken, Heilbronn (West Germany). Electronic Components Div.
**ASPECTS OF END OF LIFE DESIGN FOR SOLAR CELLS**
R. SCHILLING, K. D. RASCH, and K. ROY *In* ESA Photovoltaic Generators in Space p 71-75 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The power performances before and after electron irradiation of solar cells with different short wavelength responses and of solar cells with material or process induced low initial power output are represented. From a 10 ohm-cm crucible grown boron doped crystal, high efficiency solar cells with different shallow junctions and with different reflection minima were produced. Standard high efficiency solar cells were obtained from the same crystal with *simulated process failure and from a second crystal with low carrier* lifetime. Short circuit current and maximum power were measured after fabrication and after 1 MeV electron irradiation of fluences *of 2 times 10 to the 14th and 1 times 10 to the 15th power/sqcm.* High initial power optimized solar cells change to lower values after electron irradiation in contrast to the cells with lower initial *power but high short wavelength response. It is demonstrated* that after electron irradiation the power decrease of cells with material or process induced low initial power is smaller compared with reference cells. Author (ESA)

**N83-14707#** Technische Universitaet, Brunswick (West Germany). Inst. fuer Raumflugtechnik und Reaktortechnik.
**OPTIMIZATION OF SILICON SOLAR CELLS FOR SOLAR GENERATORS WITH CONCENTRATION**
W D. EBELING and D. REX *In* ESA Photovoltaic Generators in *Space p 77-85 Jun. 1982 refs*
Avail: NTIS HC A15/MF A01

Solar cell optimization by changing the contact grid pattern *and the thickness of the n-layer in order to reduce the electrical* series resistance, and by changing the thickness of the antireflective coating in order to adjust it to the inclined irradiation *are discussed. A mathematical model of silicon solar cells by* which the optimal solar cell type can be designed individually for each concentration system is presented. Such optimized solar cells can produce 18% more power than conventional cells in the concentrating system SARA Author (ESA)

**N83-14708*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EFFECTS OF PROCESSING AND DOPANT ON RADIATION DAMAGE REMOVAL IN SILICON SOLAR CELLS**
I. WEINBERG, H W. BRANDHORST, C. K. SWARTZ, and S. MEHTA *In* ESA Photovoltaic Generators in Space p 89-93 Jun 1982 refs
Avail. NTIS HC A15/MF A01

Gallium and boron doped silicon solar cells, processed by ion implantation followed by either laser or furnace anneal were irradiated by 1 MeV electrons and their postirradiation recovery by thermal annealing was determined. During the postirradiation anneal, gallium doped cells prepared by both processes recovered more rapidly and exhibited none of the severe reverse annealing observed for similarly processed 2 ohm-cm boron doped cells Ion implanted furnace annealed 0.1 ohm-cm boron doped cells exhibited the lowest post-irradiation annealing temperatures after irradiation The *drastically lowered recovery temperature* is attributed to the reduced oxygen and carbon content of the 0.1 ohm-cm cells Analysis based on defect properties and annealing kinetics indicates that further reduction in annealing temperature is attainable with further reduction in the silicon's carbon and/or divacancy content after irradiation. Author (ESA)

**N83-14709#** Royal Aircraft Establishment, Farnborough (England). Space and New Concepts Dept.
**OMNIDIRECTIONAL PROTON RADIATION OF THIN AND THICK SOLAR CELLS**
M. W. WALKDEN *In* ESA Photovoltaic Generators in Space p 95-102 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

Proton damage ratios, relating the damage caused by 1 MeV electrons to that caused by protons of various energies, were found for hemispherical isotropic proton conditions. The proton fluences were incident on either the front or rear of the cell. Six types of cell ranging in thickness from 50 to 250 microns were used. The ratios are much higher than those derived in earlier studies where normal incidence protons were employed, although the differences are offset by the cell cover glass or rear shield. Results are compared with proton maps AP6 and AP8.
Author (ESA)

**N83-14710#** Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes
**THE REDUCTION OF RADIATION DAMAGE IN SPACE SOLAR CELLS. A STUDY OF RADIATION DEFECTS IN SILICON (+)**
D. BIELLE-DASPET, J. BOURGOIN (Paris Univ. VII), J. BERNARD (ONERA, Toulouse), L. CASTANER-MUNOZ (ETSI *Telecomunicacion*), L. PRATT (*ESTEC, Noordwijk, Netherlands*), and R. L. CRABB *In* ESA Photovoltaic Generators in Space p 103-108 Jun. 1982 refs
(*Contract ESTEC-4510/80/NL-JS(SC)*)
Avail: NTIS HC A15/MF A01

Research data on space environmental flux and simulation conditions; electron and photon induced defects; measurement

techniques for correlated study of the microscopic macroscopic and global (electrical) degradation of the solar cell; and numerical models for space cell and degradation prediction were reviewed. The survey indicates that space factors must include possible contributions of solar flare protons, photon effects and thermal annealing due to the insolation and temperature cycles of the solar generators. An adapted set of measurement techniques must be used in order to obtain comprehensive characterization of defect and solar-cell behavior In numerical models of solar cell electrical behavior and degradation, cell structure as well as defect and carrier properties must be introduced. In space, P-type silicon should behave better than N-type; lithium in N-type gives improvement only in particular cases, and photon degradation seems to be related to boron doping when carbon and oxygen content are simultaneously low. Author (ESA)

**N83-14711#** Southampton Univ. (England). Faculty of Mathematical Sciences.
**ELECTRON AND PHOTON DEGRADATION OF BORON DOPED FZ SILICON SOLAR CELLS**
T. MARKVART, T. J. CUMBERBATCH (Thorn-EMI), M. W WALKDEN (RAE, Farnborough, Engl.), and A. A. DOLLERY *In* ESA Photovoltaic Generators in Space p 109-114 Jun. 1982 refs Sponsored by SRC
Avail: NTIS HC A15/MF A01

The short circuit current of cells damaged by electron irradiation and post-electron illumination was analyzed. It is shown that the electron damage coefficient of the cells is inversely proportional to the base resistivity, in the range 0.3 to 115 ohm-cm Photon degradation (characterized by the ratio r identical with K ph/Kel = Sigma ph/Sigma el, where K ph and Kel are functions of the base resistivity, and describe the resistivity dependence of photon and electron degradation) displays a more complicated resistivity dependence. This is explained in terms of illumination-induced defect reaction whose rate depends on the charge states of the reactants. Author (ESA)

**N83-14712#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
**RETROSPECT OF SOLAR CELL DEVELOPMENT IN WEST GERMANY**
H R. LOESCH *In* ESA Photovoltaic Generators in Space p 117-120 Jun. 1982
Avail: NTIS HC A15/MF A01

Solar cell development in West Germany from 1963 onwards is described. Author (ESA)

**N83-14713*#** National Aeronautics and Space Administration, Washington, D C.
**NASA SPACE PHOTOVOLTAIC RESEARCH AND TECHNOLOGY PROGRAMS**
J. P. MULLIN and D. J. FLOOD *In* ESA Photovoltaic Generators in Space p 121-126 Jun. 1982
Avail: NTIS HC A15/MF A01

The NASA programs for increasing conversion efficiency, reduced mass and cost, and extending operating life of photovoltaic converters and arrays and for evaluating advanced solar array concepts are outlined. Research into radiation resistance and annealing, development of thin blankets, high-power low-cost arrays, and lightweight structures for near-Earth and planetary applications are discussed. Author (ESA)

**N83-14714#** Societe Nationale Industrielle Aerospatiale, Cannes (France).
**TV-SAT SOLAR ARRAY**
G URBAIN, C RINN, and J L. BASTARD *In* ESA Photovoltaic Generators in Space p 129-133 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The electrical and mechanical performance of the TV-SAT direct television broadcasting satellite is described. The 4.5 kW end of life 7.5yr array contains 43,200 back surface reflector solar cells. The first, 3.1 kW, array consists of two identical wings, providing power during transfer and geostationary orbit Each wing is made up of four carbon fiber panels. The outboard panel of each wing is deployed at 90 deg in transfer orbit, during which the satellite is three axis stabilized. Author (ESA)

**N83-14715#** Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
**FURTHER DEVELOPMENTS OF THE ECS SOLAR ARRAY**
A. VIELEERS and F. ZIJDEMANS *In* ESA Photovoltaic Generators in Space p 135-140 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The ECS/MARECS communications satellite modular solar array is described. The baseline array configuration provides 1000 W at 50 V for a minimum lifetime of 1 yr for ECS. The array consists of two wing assemblies, each having three identical panels hinged together and connected to the spacecraft via a yoke. The lightweight panel substrates are of the rigid sandwich concept; 2240 solar cells are bonded onto each of the rectangular panels. The electrical baseline design configurations matches requirements of a regulated bus No special battery charge sections are allocated. The power generating element is a 10 ohm-cm shallow diffused 20.95 x 40.35 mm high efficiency solar cell of 180 micron nominal thickness Power-weight ratio is 26W/kg. Communication and scientific satellite applications are described. Author (ESA)

**N83-14716#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Space Operations Center.
**PRELIMINARY RESULTS OF HELIOS SOLAR GENERATOR INFLIGHT PERFORMANCE EVALUATION**
J KEHR and H. PORSCHE *In* ESA Photovoltaic Generators in Space p 143-147 Jun. 1982 refs
Avail. NTIS HC A15/MF A01

A technique which assesses the Helios 1 solar generator degradation by calculating equivalent flux from data measured in flight is presented The degradation is normalized to the 0.985 AU regulator output power value of 214 W. The measured aphelion points summarize the degradation of one orbit. Nonmeasured points are linearly interpolated. Through 14 orbits, the solar generator degraded to 37.5% of its original performance In order to separate solar cell radiation introduced degradation of the substrate from other effects, the particle intensities as measured by Helios experiments are converted to 1 MeV equivalent fluxes using damage coefficients. The temperature increase of the solar panels at the aphelion points can be related to the loss of light intensity arriving at the substrate because the absorbed intensity is approximately proportional to temperature according to Kirchhoff's law. Author (ESA)

**N83-14717#** European Space Research and Technology Center, Noordwijk (Netherlands).
**PRIMARY CALIBRATION OF HIGH EFFICIENCY SOLAR CELLS. A COMPARISON OF 1980 DATA FROM CNES, NASA (LEWIS), JPL AND RAE**
R. L. CRABB *In* ESA Photovoltaic Generators in Space p 149-155 Jun 1982 refs
Avail: NTIS HC A15/MF A01

Calibration results are presented for 10 high efficiency n/p, 1 ohm-cm, 2x4cmx250 microns silicon solar cells embodying TiPdAg contacts, TiOx antireflection coatings and 150 microns thick cerium doped microsheet coverslides. Three cells were calibrated by NASA on a high altitude aircraft, two cells by CNES balloon, two cells by JPL balloon and four cells by RAE at sea level. All data points fell within a band of + or - 1% spread in short circuit current. Author (ESA)

**N83-14718#** Societe Europeenne de Propulsion, Vernon (France).
**DEVELOPMENT AND TESTING OF A SPACECRAFT SURFACE POTENTIAL MONITOR**
D. VALENTAN, L. LEVY (ONERA, Toulouse), D. SARRAIL (ONERA, Toulouse), and J. C. LARUE (ESTEC, Noordwijk, Netherlands) *In* ESA Photovoltaic Generators in Space p 157-160 Jun. 1982
Avail: NTIS HC A15/MF A01

A surface potential monitor was developed in order to measure the electrostatic fields in solar cell covers. The measurement correlates electrostatic discharges occuring during geomagnetic substorm events and spacecraft disturbance. Monitor output can be used to drive an active spacecraft charging control system. An electromagnet induces vibration of a flat spring holding the sensing area. The spring oscillates at its fundamental frequency. Spring and sensing area mounted on an insulator. The resulting signal feeds a charge amplifier through a coaxial cable. A high impedance ac voltmeter can also be used. The monitor is designed to withstand geostationary environment for 7 yr. The test program includes environmental acceptance tests, functional acceptance tests under vacuum then environmental tests at qualification level, and geomagnetic substorm simulation tests. Author (ESA)

**N83-14719#** European Space Agency, Paris (France).
**ANNOUNCEMENT OF AN OPPORTUNITY FOR SPACE CALIBRATION OF SOLAR CELLS**
E. G. SUPPA *In its* Photovoltaic Generators in Space p 161-163 Jun. 1982
Avail: NTIS HC A15/MF A01

The ESA solar cell calibration facility (SCCE) is described. The SCCE will operate regularly on shuttle pallet satellites. Specimen reference number short circuit current, open circuit voltage, and the temperature of experiment electronics are recorded for up to 32 cells. Overall measurement accuracy is better than + or - 1%. Author (ESA)

**N83-14720#** European Space Research and Technology Center, Noordwijk (Netherlands).
**LARGE INFRARED TEST RIG FOR VACUUM TEMPERATURE CYCLING TESTS IN THE ESTEC DTC**
P. BONNOT and P. W. BRINKMANN *In* ESA Photovoltaic Generators in Space p 165-172 Jun 1982 refs
Avail: NTIS HC A15/MF A01

A rig for testing six INTELSAT 5 solar panels simultaneously was developed. It has three vertical rectangular LN2 shroud systems, which form two adjacent compartments, each 70 cm wide. Three solar panels can be suspended on rails in each compartment. The panels are almost completely enclosed by the shrouds, so that rapid transients can be achieved during temperature cycling The solar panels are heated by an array of IR lamps in each compartment. The intensity distribution in the plane of the solar panels meets the required uniformity of + or - 10%. Mechanical interfaces are designed to allow easy adaptation to other programs. Author (ESA)

**N83-14721#** Physikalisch-Technische Studien G.m.b.H., Freiburg (West Germany).
**LOSS CURRENTS OF SOLAR CELLS UNDER LOW EARTH ORBIT (LEO) CONDITIONS**
G. STASEK *In* ESA Photovoltaic Generators in Space p 173-177 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

Loss currents through plasma for different solar cell samples were measured as a function of the potential difference, distance and angle against the plasma stream, in a plasma chamber. Loss currents of 2 micro A at 200 V for a solar panel, and a lower limit for typical discharge voltages of about 200 to 300 V for solar cells are reported. Dependencies of these quantities and test results show that current and discharge voltage are governed principally by the available charged particle densities, especially electrons, and the active sample surface. The area of these surfaces determines the current in the ohmic region whereas their geometry (edges, tips) governs the discharge voltage. In the discharge region secondary electron production increases the current. Author (ESA)

**N83-14722*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**NASA SOLAR ARRAY FLIGHT EXPERIMENT Progress Report**
G. TURNER (LMSC, Sunnyvale, Calif.) and H. HILL *In* ESA Photovoltaic Generators in Space p 179-184 Jun. 1982
Avail: NTIS HC A15/MF A01

The NASA large flexible solar array space shuttle flight experiment is described. The 32 x 4 m wing is deployed from the shuttle bay, and experiments in electrical output, multiple deployment, and structural dynamics are planned. Both 2 x 4 cm and 5.9 x 5 9 cm cell assemblies on the array blanket are evaluated. Safety/hazards provisions are described, including emergency jettison provisions. Ground testing and hardware fabrication are summarized. Author (ESA)

**N83-14723#** AEG-Telefunken, Wedel (West Germany).
**ANALYTICAL PREDICTION OF THE DYNAMIC IN-ORBIT BEHAVIOR OF LARGE FLEXIBLE SOLAR ARRAYS**
G BEHRENS *In* ESA Photovoltaic Generators in Space p 187-192 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The natural motions in terms of eigenfrequencies and modes of large flexible solar arrays were determined by the finite element method (FEM). The accuracy of the FE-model was verified and improved by static and dynamic analyses Good agreement with flight test data was established. Author (ESA)

**N83-14724#** European Space Agency, Noordwikj (Netherlands).
**SPACE TELESCOPE: SOLAR PANEL ASSEMBLY THERMAL TEST ANALYSIS**
E. K. JAEKEL, G. I. M. BEERE, and B. G. M. AALDERS *In its* Photovoltaic Generators in Space p 193-200 Jun. 1982 refs
Avail. NTIS HC A15/MF A01

The Space Telescope solar panel assembly (ST-SPA) was tested in a thermal vacuum, for formal qualification and design verification of the SPA including the shunt diodes. The ST-SPA was instrumented with 60 thermocouples and 2 thermistors. In parallel to the thermal sensor readings, thermograms with an infrared camera were taken. Thermograms are reproduced, and updates of the thermal mathematical models are given. The use of a calibrated solar flux allowed an update of the thermo-optical properties for the SPA. Optical properties are: alpha S = 0.53, Sigma H = 0.76 for the rear side; and alpha S = 0.86, Sigma H = 0.78 (unloaded) for the front. Solar cell and shunt diode temperature for flight environments are included. Author (ESA)

**N83-14725#** Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.
**EXTENDIBLE AND RETRACTABLE MASTS FOR SOLAR ARRAY DEVELOPMENTS**
A. M V. VIELEERS and P R. PREISWERK (Astro Research Corp.) *In* ESA Photovoltaic Generators in Space p 201-207 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The Astromast instrument boom, and its applications in European and American space programs (e.g., L-Sat, Voyager) are described. In the continuous version the longitudinal beams (longerons) are elastically coiled when in their stowed configuration. In the articulated version the longerons are segmented and hinged, and are folded when in stowed configuration. For fully automated array deployment, the Astromast provides actuation and drive for articulations of the stowage boxes from their stowed position to the array deployment position, actuation and drive for release and reapplication of blanket preload pressure, and deployment and retraction of the solar array wing. Author (ESA)

**N83-14726#** Pilkington Bros Ltd , Ormskirk (England).
**CMX-50: A NEW ULTRA THIN SOLAR CELL COVER FOR LIGHTWEIGHT ARRAYS**
H. TAYLOR, A. F. SIMPSON, and A. A. DOLLERY (RAE, Farnborough, England) *In* ESA Photovoltaic Generators in Space p 211-214 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

Developments which extend the available thickness range of cerium glass solar cell covers down to 0.050 mm are described A continuous draw process offers a high volume, low cost solar cell cover material to integrate with thin silicon solar cells for the assembly of large area lightweight solar arrays. The cell covers are manufactured from an improved glass composition incorporating cerium dioxide This glass (CMX) maintains UV cut-off and transmission properties to match the spectral response characteristics of current silicon solar cell types, provides the necessary UV rejection and ionizing particle radiation resistance, and has a high emittance value. Author (ESA)

**N83-14727#** Departement d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France). Dept Automatique.
**ANALYTIC TOOLS FOR THE ELECTRICAL DESIGN OF SOLAR GENERATORS [OUTILS ANALYTIQUES POUR LA CONCEPTION ELECTRIQUE DE GENERATEURS SOLAIRES]**
J. P. CHRETIEN, M. ROMERO, and E. DUTRIEU (CNES, Toulouse) *In* ESA Photovoltaic Generators in Space p 215-221 Jun. 1982 refs In FRENCH
Avail: NTIS HC A15/MF A01

A probability method which can represent a given population of solar cells, or the generator which can be constructed from them is presented. Generator operation is described by a function linked to the probability that its point of operation coincides with a point on the plane (IV) where I = current, V = voltage The statistical significance of the function is calculated, and based on this value, the function is evaluted in terms of the initial cell population Application to a 60 cell population is discussed. Author (ESA)

**N83-14728#** Optical Coating Lab., Inc., Santa Rosa, Calif. Technical Products Div.
**TEXTURED SOLAR CELL COVERS FOR LIGHT WEIGHT AND HIGH PERFORMANCE**
R. P. WESTNEY, J. S. BESSEY, and I M. SACHS *In* ESA Photovoltaic Generators in Space p 223-228 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

Testing of frosted, fused silica solar cell covers is described, and the advantages of this technique are outlined. Environments studied were: 1MeV electrons, to provide a baseline for cell/cover performance; and low energy, 40 KeV protons. Electrical performance, absorptance, emissivity and mechanical strength were studied. Performance is comparable to that of polished configurations, and costs are greatly reduced. The chemical etching process used to produce the textured appearance creates surfaces relatively free from stresses and imperfections, resulting in improved mechanical strength and fewer handling losses. Very thin covers can be produced. Author (ESA)

**N83-14729#** TRW Space Technology Labs , Redondo Beach, Calif
**ULTRALIGHTWEIGHT SOLAR ARRAY TECHNOLOGY**
P. GOLDSMITH and R. KURLAND *In* ESA Photovoltaic Generators in Space p 231-240 Jun. 1982
Avail: NTIS HC A15/MF A01

Flat fold array technology is described, and performance for a range of missions and power levels is predicted. The array employs large area flat panel flexible substrates. The solar cells are adhesively bonded to a thin Kapton substrate to form individual panel assemblies. Any number of these panel assemblies may be joined together to make a blanket assembly. A container assembly protects each blanket assembly when stowed, and a tension guide wire assembly controls the flexible blanket shape when fully extended. Blanket extension and retraction are achieved through a motor powered lightweight trilongeron coilable lattice mast assembly. Ground and zero gravity flight tests on prototype array assemblies are successful Author (ESA)

**N83-14730#** AEG-Telefunken, Wedel (West Germany).
**THE DESIGN OF THE L-SAT SOLAR ARRAY**
L. GERLACH, G. W. MARKS (Spar Aerospace Ltd., Toronto), E. QUITTNER (Spar Aerospace Ltd., Toronto), J. RENSHALL (Spar Aerospace, Ltd., Toronto), and R. SWANENBURG (Royal Netherlands Aircraft Factories Fokker, Amsterdam) *In* ESA Photovoltaic Generators in Space p 241-255 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The concept, requirements, mission phases, design, analyses, and testing of a large, modular, deployable, flexible/foldable blanket, Sun tracking solar array are described. The same design is capable of providing 1.9 kW to 6.5 kW end-of-10 yr geosynchronous equinox power per spacecraft by simple modular changes, with further growth to 7.8 kW by means of structral modifications. The array undergoes partial deployment after insertion into the transfer orbit to develop 3 kW minimum and is fully deployed after apogee engine firing Author (ESA)

**N83-14731#** AEG-Telefunken, Wedel (West Germany) Neue Technologien.
**SOLAR ARRAYS FOR SMALL SCIENTIFIC SATELLITES**
J. KOCH *In* ESA Photovoltaic Generators in Space p 257-261 Jun 1982
Avail: NTIS HC A15/MF A01

The layout and manufacturing sequence of the arrays for the AMPTE 1 and OSCAR 9 satellites are described, and the handmade manufacturing approach is assessed. Handmade arrays need a higher manpower effort, trained qualified personnel, and longer manufacturing time for certain manufacturing steps (especially welding). Advantages include reduced tooling effort, higher flexibility e.g. at design changes, and shorter preparation time between project go ahead and manufacturing start. Application is limited to arrays with 2000 cells maximum. Author (ESA)

**N83-14732*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DETERMINATION OF OPTIMUM SUNLIGHT CONCENTRATION LEVEL IN SPACE FOR 3-5 CASCADE SOLAR CELLS**
H. B. CURTIS *In* ESA Photovoltaic Generators in Space p 265-270 Jun. 1982 refs
Avail. NTIS HC A15/MF A01

Current-voltage curves were calculated for each cell in a cascade structure using a solar cell diode equation and superposition. Terms for the light generated current, diffusion current, space charge recombination current and series and shunt resistance are included. Individual current voltage curves are added in series with ohmic resistance losses for the cell interconnects to obtain the cascade cell performance. Temperature was varied with concentration, using several models, and ranged from 55 C at one Sun to between 80 and 200 C at 100 Suns. A variety of series resistance and internal resistances were used. Coefficients of the diffusion and recombination terms are strongly temperature dependent. The study indicates that maximum efficiency (30%) occurs in the 50 to 100X Sun concentration range, provided series resistance is below 0.015 ohm-sq cm and cell temperature is 80 C at 100 Suns. Author (ESA)

**N83-14733#** Societe Nationale Industrielle Aerospatiale, Cannes (France).
**ARABSAT SOLAR ARRAY**
R. LAGET, C LONG, and P. GUYOT *In* ESA Photovoltaic Generators in Space p 271-275 Jun 1982 refs
Avail: NTIS HC A15/MF A01

The electrical and mechanical performances of the ARABSAT medium class satellite solar array are described. Primary power (1.3 kW end of 7 yr life) is provided by two separate Sun-oriented solar array wings equipped with back surface reflector. The solar generator is directly derived from graphite epoxy wing technology. It is suitable for telecommunication satellites owing to its very good power/mass ratio (21.4 W/kg), the three axis stabilization

and the partial deployment of the solar array during transfer orbit. Author (ESA)

**N83-14735#** British Aerospace Dynamics Group, Bristol (England).
**SOLDERED SOLAR ARRAYS**
H. C. ALLEN *In* ESA Photovoltaic Generators in Space p 287-289 Jun. 1982
Avail: NTIS HC A15/MF A01

The ability of soldered interconnects to withstand a combination of long life and severe environmental conditions was investigated. Improvements in joint life from the use of solder mixes appropriate to low temperature conditons were studied. Solder samples were placed in a 150 C oven for 5 weeks (= 12 yr at 80 C, or 24 at 70 C according to Arrhenius's rule). Conventional and high solder melting point array samples underwent 1000 thermal cycles between -186 and 100 C. Results show that conventional and lead rich soldered arrays can survive 10 yr geostationary orbit missions. Author (ESA)

**N83-14736#** British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
**PROGRESS AND DEVELOPMENT STATUS OF THE SPACE TELESCOPE SOLAR ARRAY**
R. H. W. FOX *In* ESA Photovoltaic Generators in Space p 263-298 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

The development status of the Space Telescope solar array flexible solar cell blanket deployment mechanism, primary deployment mechanism and array orientation subsystems are reviewed. The array has a life time requirement of 5 yr. Design features include the ability to be operated manually in space and replaced as a complete unit in-orbit. Since the Space Telescope itself is too large to test in a conventional, satellite manner, thermal and dynamic analyses were used to prove the design. The deployed array inertia of 700 kg/sqm per wing and the extreme pointing accuracy requirement of the Space Telescope require an extremely sophisticated array orientation subsystem. Author (ESA)

**N83-14737#** British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
**FUTURE DEVELOPMENTS AND APPLICATIONS FOR THE SPACE TELESCOPE SOLAR ARRAY**
R H W. FOX *In* ESA Photovoltaic Generators in Space p 299-303 Jun 1982
Avail NTIS HC A15/MF A01

The adaptation of the Space Telescope solar array to experimental platforms or space shuttle limited duration missions is considered. Using the present design technology, a power growth up to 10 kW is envisaged. Geostationary orbit power versus mass for variants up to 8kW (10 year equinox) are shown Power can be increased by adding solar panel assemblies (SPA) to the blankets. The present 8 in drum diameter and flexible power transfer harness enables a further SPA to be added by extending the Bi-Stem booms an additional 1.2 m, giving 6 kW beginning of life (BOL). By deletion when not required of shadow diodes (+4%) and the use of higher efficiency cells (+5%) a further power growth to 6.7kW BOL is possible with negligible impact on the present design, and qualification status. For increases of SPA above 6 per half wing, 24 total, the Bi-Stem size must be increased, Alternatively, Bi-Stem type and drum diameter increase may be possible. Both modifications are straightforward but require partial requalification. Author (ESA)

**N83-14738#** British Aerospace Dynamics Group, Bristol (England).
**ANTI-STATIC COAT FOR SOLAR ARRAYS**
C. N. FELLAS *In* ESA Photovoltaic Generators in Space p 305-307 Jun. 1982 refs
Avail: NTIS HC A15/MF A01

A Kapton based composite material, suitable as a substrate for flexible solar arrays, was designed, constructed and tested under electron energies ranging from 5 to 30 keV The rear of the array under adverse eclipse conditions (-197 C) produced voltages well below the discharge threshold. An antistatic coat suitable as a front cover for solar arrays is also described. The thermal and optical transmission characteristics were tested and are satisfactory, but the UV and particle degradation of the Tedlar material needs to be evaluated. Author (ESA)

**N83-14741#** Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
**FUEL AND ELECTRICITY GENERATION FROM ILLUMINATION OF INORGANIC INTERFACES Interim Technical Report**
M. S. WRIGHTON 27 Aug 1982 39 p refs Submitted for publication Sponsored in part by DOE, GTE Labs. and Dow Chemical Co.
(Contract N00014-75-C-0880; NR PROJ. 051-579)
(AD-A119305, TR-34) Avail: NTIS HC A03/MF A01 CSCL 07B

Semiconductor-based photoelectrochemical devices represent good systems for the sustained, direct conversion of light to chemical or electrical energy. The interfacial structure, energetics, and and redox kinetics control the overall performance of such systems. Examples of improvements in efficiency and durability of photoelectrochemical cells stemming from chemical manipulations at semiconductor/liquid electrolyte interfaces illustrate the critical importance of understanding interface properties Author (GRA)

**N83-14751#** California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
**SMALL-SCALE ENERGY-TECHNOLOGY PROJECTS IN THE PACIFIC TERRITORIES: A CASE-STUDY REVIEW**
C. W. CASE and M. K ACTOUKA (Hawaii Univ.) Sep. 1981 47 p refs Presented at the Conf. on Ocean Resource Develop. in the Pacific, Honolulu, Hawaii, 13-15 Oct 1981
(Contract W-7405-ENG-48)
(DE82-001338; LBL-12818, CONF-811053-1) Avail. NTIS HC A03/MF A01

A small-scale energy projects funded in the Pacific Territories attempts to be appropriate for developing Pacific island communities by using local labor and materials, using renewable resources, incorporating simple technologies, and being culturally sensitive. During the last three years the projects were monitored. Five case studies were prepared which illustrate elements and define features which contribute or hinder technology transfer. Case studies include a typhoon-proof greenhouse on Guam, wood stoves and small solar devices on Yap, various devices built at a youth educational facility on Ponape, an unusual solar hot water system on Majuro, and a solar fish drying facility on an outer Truk island. DOE

**N83-14761#** Sandia Labs., Albuquerque, N. Mex.
**DEVELOPMENT EFFORT OF SHEET MOLDING COMPOUND (SMC) PARABOLIC TROUGH PANELS**
P. A KIRSCH (Budd Co., Fort Washington, Pa.) and R. L. CHAMPION 1982 17 p refs Presented at the 37th Ann. Tech. Conf. on Reinforced Plastics/Composites, Washington, D.C., 11 Jan. 1982
(Contract DE-AC04-76DP-00789)
(DE82-000841, CONF-820103-1) Avail. NTIS HC A02/MF A01

The approach taken to meet the objectives was to design the parabolic panel, fabricate a prototype die, choose an SMC formulation and mold the glass and SMC together into a vertex to rim mirrored panel. The main thrust of the program was to successfully co-mold a mirrored glass sheet with the SMC. Results indicate that mirrored glass sheets, if properly strengthened to withstand the temperature and pressure of the molding process, can be successfully molded with SMC in a single press stroke using standard compression molding techniques. The finalized design of the trough panel is given. The SMC formulation chosen is a low shrink, low profile SMC using 40% by weight one inch chopped glass fibers in a uv stabilized polyester resin matrix. A program to test for the adhesion between mirrored glass sheets and the SMC is discussed briefly. DOE

**N83-14762#** Lincoln Housing Authority, Nebr
**RESIDENTIAL PHOTOVOLTAIC EXPERIMENT STATION DATA SYSTEM**
H A. FENTON and C. H MUCH 1981 7 p Presented at IECI '81, San Francisco, 9-12 Nov. 1981
(Contract DE-AC02-76ET-20279)
(DE82-001646; DOE/ET-20279-155, CONF-811110-2) Avail: NTIS HC A02/MF A01

A microprocessor-based system acquires data from and controls residential photovoltaic power system evaluation experiments Each station monitors 30 or more experiment sites. Unique features are the use of data from one site to control another and the easy addition, removal, or modification of sensors or sites without disruption of the system. DOE

**N83-14763#** AEG-Telefunken, Wedel (West Germany). Fachbereich Neue Technologien, Raumfahrt.
**SYSTEM ANALYSIS, DESIGN, CONSTRUCTION AND COMMISSION OF A PHOTOVOLTAIC POWER PLANT FOR SUPPLY OF BROADCASTING EQUIPMENT Final Report, Apr. 1981**
D. KEAVENY Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 124 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-125; ISSN-0340-7608) Avail. NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 23,50

A photovoltaic power plant to supply a broadcasting transmitter was designed, built and tested in order to validate the application of photovoltaic power plants for the self sufficient power supply of broadcasting equipment. Berlin was chosen for data collection and field testing. A 600 W transmitter was installed as load. After construction and commissioning, the plant, (solar generator, energy conditioning and control, storage battery, and transmitter) was tested for 1 yr. The field testing demonstrates that in Central European latitudes photovoltaic power plants can guarantee a self supporting operation of broadcasting equipment. Author (ESA)

**N83-14764#** Schott Glaswerke, Mainz (West Germany)
**FLAT PLATE SOLAR COLLECTORS Final Report, Jul. 1980**
E. HUSSMANN Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 100 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-139; ISSN-0340-7608) Avail: NTIS HC A05/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 21

Flat plate collectors of conventional design with high efficiency were developed. A special metal sheet fastened to the absorber led to a construction which is gas tight and tolerates no flow conditions. Such collectors have a long service life. The influence of the cover system on efficiency was investigated by computer simulation. The type of panel, the number and selective coatings on the panel or on the absorber were varied. Loads from the environment and operating loads e.g., pressure rise related to temperature rise and thermal stresses were analyzed, especially for cover systems and the bonding of the panels, to the absorber. Prototypes were built and tested. Author (ESA)

**N83-14808#** Cologne Univ. (West Germany).
**DETERMINATION OF THE RADIATION BUDGET AT THE EARTH'S SURFACE FROM SATELLITE DATA**
W MOESER *In its* Satellite Meas. of the Earth Radiation Budget p 156-170 Jul. 1982 refs
Avail: NTIS HC A08/MF A01

The determination of the global Earth surface radiation budget and of the surface albedo is presented. The problem of determining the solar part of the radiation balance equation, especially the global radiation, was solved in various studies because of its interdisciplinary relevance not only for meteorology, but also for agriculture and solar energy purposes The results show that the errors can be kept on the order of about 10% to 15% for hourly values, but high accuracy is obtained for longer time intervals The problem of a proper comparison method between the two different measuring geometries (surface measurement - satellite measurement) remains. Surface albedos are to be derived from satellite images except for mountainous and inhomogeneous landscapes because of the various effects of shadowing which can hardly be simulated by radiative transfer theory.
Author (ESA)

**N83-15807*#** National Aeronautics and Space Administration, Washington, D C
**NASA-OAST PROGRAM IN PHOTOVOLTAIC ENERGY CONVERSION**
J. P. MULLIN and D. J. FLOOD *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 1-4 1982
Avail: NTIS HC A12/MF A01 CSCL 10A

The NASA program in photovoltaic energy conversion includes research and technology development efforts on solar cells, blankets, and arrays. The overall objectives are to increase conversion efficiency, reduce mass, reduce cost, and increase operating life. The potential growth of space power requirements in the future presents a major challenge to the current state of technology in space photovoltaic systems. Author

**N83-15808*#** Pennsylvania Univ., Philadelphia.
**NEW SILICON CELL DESIGN CONCEPTS FOR 20 PERCENT AMI EFFICIENCY**
M. WOLF *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 5-12 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

The basic design principles for obtaining high efficiency in silicon solar cells are reviewed. They critically involve very long minority carrier lifetimes, not so much to attain high collection efficiency, but primarily for increased output voltages. Minority carrier lifetime, however, is sensitive to radiation damage, and particularly in low resistivity silicon, on which the high efficiency design is based. Radiation resistant space cells will therefore have to follow differing design principles than high efficiency terrestrial cells Author

**N83-15809*#** Applied Solar Energy Corp., City of Industry, Calif.
**RECENT DEVELOPMENTS IN THIN SILICON SOLAR CELLS**
F HO and P. ILES *In* NASA. Lewis Research Center Space Photovoltaic Res and Technol 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 17-24 1982
Avail: NTIS HC A12/MF A01 CSCL 10A

Fifty micron thick cells 2x4 sq cm area with coplanar back contacts were made with good yield, and with output equivalent to conventional top/bottom contact cells of the same thickness A wraparound junction (WAJ) design was selected, and used successfully. The low alpha cells delivered were all above 12%, the average efficiency was 13% and the best was 14%. The overall yield was 35 to 40%, comparable to that for conventional 50 micron cells The process sequence was moderately complex, but showed good reproducibility The CBC cells performed well under several important environmental tests. High alpha CBC cells were made, with about 1% increase in conversion efficiency. The most important design criteria were the choice of back surface N+ and P+ areas. Author

**N83-15810*#** Spire Corp., Bedford, Mass.
**LARGE AREA SPACE SOLAR CELL ASSEMBLIES**
M. B. SPITZER and M. J. NOWLAN *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 25-36 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

Development of a large area space solar cell assembly is presented. The assembly consists of an ion implanted silicon cell and glass cover The important attributes of fabrication are (1) use of a back surface field which is compatible with a back surface reflector, and (2) integration of coverglass application and call fabrication. Author

**N83-15811*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SIMULATED SPACE FLIGHT TESTING OF COMMERCIAL TERRESTRIAL SILICON CELLS**
P. M. STELLA and T. F. MIYAHIRA *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 37-43 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

Low cost silicon solar cells manufactured for the terrestrial market are examined for possible space flight use. The results of preliminary space environmental testing are reported and discussed. In addition, a number of possible obstacles to the use of these cells is examined It is concluded that the terrestrial industry could provide an extremely low cost and reliable cell for space use. Author

**N83-15812*#** Nebraska Univ., Lincoln. Dept. of Electrical Engineering.
**DIFFUSION LENGTH MEASUREMENTS IN SOLAR CELLS: AN ANALYSIS AND COMPARISON OF TECHNIQUES**
J A WOOLLAM (Universal Energy Systems), A. A. KHAN, R J. SOUKUP, and A. M. HERMANN (Midwest Research Inst.) *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 45-56 1982 refs
(Contract NAG3-120)
Avail: NTIS HC A12/MF A01 CSCL 10A

A brief review of the major techniques for measuring minority carrier diffusion lengths in solar cells is given. Emphasis is placed on comparing limits of applicability for each method, especially as applied to silicon cells or to gallium arsenide cells, including the effects of radiation damage. Author

**N83-15813*#** Varian Associates, Palo Alto, Calif.
**PROGRESS TOWARD CASCADE CELLS MADE BY OM-VPE**
P. G. BORDEN, R. A. LARUE, and M. J. LUDOWISE *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 57-65 1982 refs Sponsored in part by DOE
(Contract NAS3-22232)
Avail: NTIS HC A12/MF A01 CSCL 10A

Organometallic Vapor Phase Epitaxy (COM-VPE) was used to make a sophisticated monolithic cascade cell, with a peak AMO efficiency of 16.6%, not corrected for 14% grid coverage. The cell has 9 epitaxial layers. The top cell is 1.35 microns thick with a 0 1 micron thich emitter. Both cells are heteroface n-p structures. The cascade cell uses metal interconnects. Details of growth and processing are described. Author

**N83-15814*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DETERMINATION OF OPTIMUM SUNLIGHT CONCENTRATION LEVEL IN SPACE FOR 3-5 CASCADE SOLAR CELLS**
H. B CURTIS *In its* Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 69-78 1982 refs Previously announced as 82N-32853
Avail: NTIS HC A12/MF A01 CSCL 10A

The optimum range of concentration levels in space for III-V cascade cells was calculated using a realistic solar cell diode equation. Temperature was varied with concentration using several models and ranged from 55 C at 1 sun to between 80 and 200 C at 100 suns A variety of series resistance and internal resistances were used. Coefficients of the diffusion and recombination terms are strongly temperature dependent. The study indicates that the maximum efficiency of 30 percent occurs in the 50 to 100 sun concentration range provided series resistance is below 0.015 ohm-sq cm and cell temperature is about 80 C at 100 suns. Author

**N83-15815*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SOLAR ENERGY CONVERSION USING SURFACE PLASMONS FOR BROADBAND ENERGY TRANSPORT**
L. M. ANDERSON *In its* Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 79-87 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

A new strategy for efficient solar energy conversion based on parallel processing with surface plasmons is introduced The approach is unique in identifying: (1) a broadband carrier with suitable range for energy transport, and (2) a technique to extract more energy from the more energetic photons, without sequential losses or unique materials for each frequency band The aim is to overcome the fundamental losses associated with the broad solar spectrum and to achieve a higher level of spectrum splitting than has been possible in semiconductor systems. Author

**N83-15816*#** Air Force Wright Aeronautical Labs, Wright-Patterson AFB, Ohio.
**AIR FORCE DEVELOPMENT OF THIN GAAS SOLAR CELLS**
K. MASLOSKI *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 93-97 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

The advantages of gallium arsenide (GaAs) over silicon (Si) type solar cells are well documented However, two major disadvantages are weight and cost Several ideas have recently surfaced that, if successful, will diminish these disadvantages. The CLEFT peeled film technique and the galicon cell are two of the more promising approaches Low weight, low cost, high efficiency GaAs solar cell research is summarized. Author

**N83-15817*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena
**PROGRESS TOWARD THIN-FILM GAAS SOLAR CELLS USING A SINGLE-CRYSTAL SI SUBSTRATE WITH A GE INTERLAYER**
Y. C. M. YEH, K. L. WANG, and S ZWERDLING *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 99-104 1982
(Contract NAS7-100)
Avail: NTIS HC A12/MF A01 CSCL 10A

Development of a technology for fabricating light-weight, high-efficiency, radiation-resistant solar cells for space applications is reported. The approaches currently adopted are to fabricate shallow homojunction n(+)/p as well as p/n AlGaAs-heteroface GaAs solar cells by organometallic chemical vapor deposition (OM-CVD) on single-crystal Si substrates using in each case, a thin Ge epi-interlayer first grown by CVD This approach maintains the advantages of the low specific gravity of Si as well as the high efficiency and radiation-resistant properties of the GaAs solar cell which can lead to greatly improved specific power for a solar array. The growth of single-crystal GaAs epilayers on Ge epi-interlayers on Si substrates is investigated. Related solar cell fabrication is reviewed. Author

**N83-15818*#** Rensselaer Polytechnic Inst., Troy, N. Y.
**DIFFUSED P+-N SOLAR CELLS IN BULK GAAS**
J. M. BORREGO and S. K. GHANDHI *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 105-108 1982 refs
(Contract NAG3-188)
Avail: NTIS HC A12/MF A01 CSCL 10A

Recently melt grown GaAs, made by liquid encapsulation techniques, has become available. This material is of sufficiently good quality to allow the fabrication of solar cells by direct diffusion. Results obtained with p(+)/n junction solar cells made by zinc diffusion are described. The quality of bulk GaAs for this application is evaluated. Author

**N83-15819*#** Rockwell International Corp., Thousand Oaks, Calif. Microelectronics Research and Development Center.

**ADVANCES IN LARGE-DIAMETER LIQUID ENCAPSULATED CZOCHRALSKI GAAS**

R. T. CHEN, D. E. HOLMES, and C. G. KIRKPATRICK *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 109-122 1982 refs

(Contract NAS3-22224; NAS3-22235)

Avail: NTIS HC A12/MF A01 CSCL 10A

The purity, crystalline perfection, and electrical properties of n- and p-type GaAs crystals grown by the liquid encapsulated Czochralski (LEC) technique are evaluated. The determination of the dislocation density, incidence of twinning, microstructure, background purity, mobility, and minority carrier diffusion length is included. The properties of the LEC GaAs crystals are generally comparable to, if not superior to those of small-diameter GaAs material grown by conventional bulk growth techniques. As a result, LEC GaAs is suitable for application to minority carrier devices requiring high-quality and large-area substrates. Author

**N83-15820*#** Hughes Research Labs., Malibu, Calif.

**GAAS SOLAR CELLS FOR CONCENTRATOR SYSTEMS IN SPACE**

R. Y. LOO, R. C. KNECHTLI, and G. S. KAMATH *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 123-130 1983 refs

(Contract NAS3-22227)

Avail: NTIS HC A12/MF A01 CSCL 10A

Cells for operation in space up to more than 100 suns were made, and an AMO efficiency of 21% at 100 suns with these cells was obtained. The increased efficiency resulted not only from the higher open circuit voltage associated with the higher light intensity (higher short circuit current); it also benefitted from the increase in fill factor caused by the lower relative contribution of the generation recombination current to the forward bias current when the cell's operating current density is increased. The experimental cells exhibited an AMO efficiency close to 16% at 200 C. The prospect of exploiting this capability for the continuous annealing of radiation damage or for high temperature missions (e.g., near Sun missions) remains therefore open. Space systems with concentration ratios on the order of 100 suns are presently under development. The tradeoff between increased concentration ratio and increased loss due to the cell's series resistance remains attractive even for space applications at a solar concentrator ratio of 100 suns In the design of contact configuration with low enough series resistance for such solar concentration ratios, the shallow junction depth needed for good radiation hardness and the thin AlGaAs layer thickness needed to avoid excessive optical absorption losses have to be retained. Author

**N83-15821*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**THE EFFECT OF DIFFERENT SOLAR SIMULATORS ON THE MEASUREMENT OF SHORT-CIRCUIT CURRENT TEMPERATURE COEFFICIENTS**

H. B. CURTIS and R. E. HART, JR. *In its* Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 131-136 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 10A

Gallium arsenide solar cells are considered for several high temperature missions in space. Both near-Sun and concentrator missions could involve cell temperatures on the order of 200 C. Performance measurements of cells at elevated temperatures are usually made using simulated sunlight and a matched reference cell Due to the change in bandgap with increasing temperature at portions of the spectrum where considerable simulated irradiance is present, there are significant differences in measured short circuit current at elevated temperatures among different simulators. To illustrate this, both experimental and theoretical data are presented for gallium arsenide cells. Author

**N83-15822*#** Florida Univ., Gainesville.

**DEFECTS AND ANNEALING STUDIES IN 1-ME ELECTRON IRRADIATED (ALGA)AS-GAAS SOLAR CELLS**

S. S. LI, W. L. WANG, R. Y. LOO (Hughes Research Labs.), and W. P. RAHILLY (AFWAL) *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 137-144 1982 refs Sponsored in part by AFWAL

Avail: NTIS HC A12/MF A01 CSCL 10A

The deep-level defects and recombination mechanisms in the one-MeV electron irradiated (AlGa)As-GaAs solar cells under various irradiation and annealing conditions are discussed. Deep-level transient spectroscopy (DLTS) and capacitance-voltage (CV) techniques were used to determine the defect and recombination parameters such as energy levels and defect density, carrier capture cross sections and lifetimes for both electron and hole traps as well as hole diffusion lengths in these electron irradiated GaAs solar cells. GaAs solar cells used in this study were prepared by the infinite solution melt liquid phase epitaxial (LPE) technique at Hughes Research Lab., with (Al0.9Ga0.1)-As window layer, Be-diffused p-GaAs layer on Sn-doped n-GaAs or undoped n-GaAs active layer grown on n(+)-GaAs substrate. Mesa structure with area of 5.86x1000 sq cm was fabricated. Three different irradiation and annealing experiments were performed on these solar cells. Author

**N83-15823*#** Rome Air Development Center, Hanscom AFB, Mass.

**DEFECT BEHAVIOR IN ELECTRON-IRRADIATED BORON- AND GALLIUM-DOPED SILICON**

P. J. DREVINSKY and H. M. DEANGELIS *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol p 145-155 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 10A

Production and anneal of defects in electron-irradiated, float-zone silicon solar cells were studied by DLTS. In boron- and gallium-doped, n+-p cells, dominant defects were due to the divacancy, carbon interstitial, and carbon complex. Results suggest that the DLTS peak normally ascribed to carbon complexes also involves gallium. For gallium- and, to a lesser extent, boron-doped samples, damaged lifetime shows substantial recovery only when the carbon-complex peak has annealed out at 400 C. In boron-doped, n+-p-p+ cells, a minority carrier trap (E1) was also observed by DLTS in cells with a boron p+, but not in those with an aluminum p+ back. A level at Ev + 0.31 eV appeared upon 150 C annealing (E1 out) in both p+ back types of samples.

Author

**N83-15824*#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

**COLD CRUCIBLE CZOCHRALSKI FOR SOLAR CELLS**

T. M. TRUMBLE *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 157-161 1982 refs

Avail: NTIS HC A12/MF A01 CSCL 10A

The efficiency and radiation resistance of present silicon solar cells are a function of the oxygen and carbon impurities and the boron doping used to provide the proper resistivity material. The standard Czochralski process used grow single crystal silicon contaminates the silicon stock material due to the use of a quartz crucible and graphite components. The use of a process which replaces these elements with a water cooled copper to crucible has provided a major step in providing gallium doped (100) crystal orientation, low oxygen, low carbon, silicon. A discussion of the Cold Crucible Czochralski process and recent float Zone developments is provided. L.F.M.

**N83-15825*#** Lincoln Lab., Mass. Inst. of Tech., Lexington.
**MICRODISTRIBUTION OF OXYGEN IN SILICON AND ITS EFFECTS ON ELECTRONIC PROPERTIES**
H. C. GATOS, B. Y. MAO, K. NAUKA, and J. LAGOWSKI *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 163-169 1982 refs
(Contract NSG-3017)
Avail: NTIS HC A12/MF A01 CSCL 10A

The effects of interstitial oxygen on the electrical characteristics of Czochralski-grown silicon crystals were investigated for the first time on a microscale. It was found that the generation of thermal donors is not a direct function of the oxygen concentration. It was further found that the minority carrier life-time decreases with increasing oxygen concentration, on a microscale in as-grown crystals. It was thus shown, again for the first time, that oxygen in as grown crystals is not electronically inert as generally believed. Preannealing at 1200 C commonly employed in device fabrication, was found to suppress the donor generation at 450 C and to decrease the deep level concentrations. Author

**N83-15826*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**RADIATION DAMAGE AND ANNEALING IN LARGE AREA N+/P/P+ GAAS SHALLOW HOMOJUNCTION SOLAR CELLS**
D J. FLOOD, D. J. BRINKER, C. K. SWARTZ, R. E. HART, JR., and J C. C. FAN (MIT, Lincoln Lab., Lexington) *In its* Space Photovoltaic Res and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 179-184 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

Annealing of radiation damage was observed for the first time in VPE-grown, 2- by 2-cm, n+/p/p+ GaAs shallow homojunction solar cells. Electrical performance of several cells was determined as a function of 1-MeV electron fluence in the range of 10 to the 13th power to 10 to the 15th power e-/sq cm and as a function of thermal annealing time at various temperatures. Degradation of normalized power output after a fluence of 10 to the 15th power 1-MeV electrons/sq cm ranged from a low of 24 to 31 percent of initial maximum power. Normalized short circuit current degradation was limited to the range from 10 to 19 percent of preirradiated values. Thermal annealing was carried out in a flowing nitrogen gas ambient, with annealing temperatures spanning the range from 125 to 200 C. Substantial recovery of short circuit current was observed at temperatures as low as 175 C. In one case improvement by as much as 10 percent of the postirradiated value was observed. The key features of these cells are their extremely thin emitter layers (approxmately 0.05 micrometers), the absence of any Al sub xGd sub 1-x As passivating window layer, and their fabrication by vapor phase epitaxy. Author

**N83-15827*#** Communications Satellite Corp., Clarksburg, Md.
**BASIS FOR EQUIVALENT FLUENCE CONCEPT IN SPACE SOLAR CELLS**
A. MEULENBERG *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 185-194 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

The equivalent fluence concept is defined, and its use and potential problems are noted. Silicon and GaAs solar cells are compared in a radiation environment. The analysis indicates that valid equivalent fluence values may be easier to obtain in GaAs than in silicon. Author

**N83-15828*#** Florida Univ., Gainesville.
**GROWN-IN DEFECTS AND DEFECTS PRODUCED BY 1-ME ELECTRON IRRADIATED IN AL0.3GA0.7AS P-N JUNCTION SOLAR CELLS**
S. S. LI, K. W. TENG, D. W. SCHOENFELD, and W. P. RAHILLY (AFWAL) *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 195-200 1982 refs Sponsored in part by AFWAL
Avail: NTIS HC A12/MF A01 CSCL 10A

Studies of grown-in defects and defects produced by the one-MeV electron irradiation in Al sub 0.3 Ga sub 0.7As p-n junction solar cells fabricated by liquid phase epitaxial (LPE) technique were made for the unirradiated and one-MeV electron irradiated samples, using DLTS and C-V methods. Defect and recombination parameters such as energy level, defect density, carrier capture cross sections and lifetimes were determined for various growth, annealing, and irradiation conditions. L.F.M.

**N83-15829*#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
**PROGRESS IN DEVELOPING HIGH PERFORMANCE SOLAR BLANKETS AND ARRAYS**
J. SCOTT-MONCK *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 201-209 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

The development of high efficiency, ultrathin silicon solar cells offers both opportunity and challenge. It is possible to consider 400 W/kg blanket designs by using this cell in conjuction with flexible substrates, ultrathin covers and welded interconnects. By designing array structure which is mechanically and dynamically compatible with very low mass blankets, solar arrays with a specific power approaching 200 W/kg are achievable. Further improvements in blanket performance (higher power and lower mass per unit area), which could come from the implementation of higher efficiency cells operating at lower temperatures (silicon or GaAs), and the use of encapsulants, would result in the development of 300 W/kg solar arrays. L.F.M.

**N83-15830*#** TRW Defense and Space Systems Group, Redondo Beach, Calif.
**MINIATURIZED CASSEGRAINIAN CONCENTRATOR CONCEPT DEMONSTRATION**
R. E. PATTERSON and H. S. RAUSCHENBACH *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 211-221 1982 refs
(Contract NAS8-34131)
Avail: NTIS HC A12/MF A01 CSCL 10A

High concentration ratio photovoltaic systems for space applications have generally been considered impractical because of perceived difficulties in controlling solar cell temperatures to reasonably low values. A miniaturized concentrator system is now under development which surmounts this objection by providing acceptable solar cell temperatures using purely passive cell cooling methods. An array of identical miniaturized, rigid Cassegrainian optical systems having a low f-number with resulting short dimensions along their optical axes are rigidly mounted into a frame to form a relatively thin concentrator solar array panel. A number of such panels, approximately 1.5 centimeters thick, are wired as an array and are folded against one another for launch in a stowed configuration. Deployment on orbit is similar to the deployment of conventional planar honeycomb panel arrays or flexible blanket arrays. The miniaturized concept was conceived and studied in the 1978-80 time frame. Progress in the feasibility demonstration to date is reported. L.F.M.

**N83-15831*#** Jet Propulsion Lab., California Inst of Tech., Pasadena.
**THE COURSE OF SOLAR ARRAY WELDING TECHNOLOGY DEVELOPMENT**
P. M. STELLA *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 223-230 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

Solar array welding technology is examined from its beginnings in the late 1960's to the present. The U.S. and European efforts are compared, and significant similarities are highlighted. The utilization of welding technology for space use is shown to have been influenced by a number of subtle, secondary factors.
Author

**N83-15832*#** Jet Propulsion Lab, California Inst of Tech, Pasadena.
**A PRELIMINARY EVALUATION OF A POTENTIAL SPACE WORTH ENCAPSULANT**
J SCOTT-MONCK *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol 1982. High Efficiency, Radiation Damage, and Blanket Technol. p 231-236 1982 refs
Avail. NTIS HC A12/MF A01 CSCL 10A

A new polymer polyimide possessing optical and mechanical properties potentially suitable for space applications now exists. A preliminary evaluation of the material indicates that in its present state of development, the polyimide is not ready for space qualification Further efforts to increase molecular weight and purify the consituents used to synthesize it are warranted. Activities addressing these needs are now being pursued If these approaches prove successful, additional testing will take place with an emphasis on synergistic effects. L.F.M

**N83-15833*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**MICROSTRUCTURAL ANALYSIS OF SOLAR CELL WELDS**
T. J. MOORE, G. K. WATSON, and C. R. BARAONA *In its* Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 237-249 1982 refs
Avail· NTIS HC A12/MF A01 CSCL 10A

Parallel-gap resistance welding of silicon solar cells with copper interconnects results in complex microstructural variations that depend on the welding variables At relatively low heat input solid-state welds are produced. At medium heat the Ag-Cu eutectic forms resulting in a braze joint. High heat produces a fusion weld with complete melting of the silver layer on the silicon solar cell. If the silicon is also melted, cracking occurs in the silicon cell below the weld nugget. These determinations were made using light microscopy, microprobe, and scanning electron microscopy analyses. Author

**N83-15834*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**EVALUATION OF SOLAR CELL WELDS BY SCANNING ACOUSTIC MICROSCOPY**
S. J. KLIMA, W. E. FREY, and C. R. BARAONA *In its* Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol p 251-258 1982 refs
Avail: NTIS HC A12/MF A01 CSCL 10A

Scanning laser acoustic microscopy was used to nondestructively evaluate solar cell interconnect bonds made by resistance welding. Both copper-silver and silver-silver welds were analyzed The bonds were produced either by a conventional parallel-gap welding technique using rectangular electrodes or new annular gap design with a circular electrode cross section. With the scanning laser acoustic microscope, it was possible to produce a real time television image which reveales the weld configuration as it relates to electrode geometry. The effect of electrode misalinement with the surface of the cell was also determined. A preliminary metallographic analysis was performed on selected welds to establish the relationship between actual size and shape of the weld area and the information available from acoustic micrographs. Author

**N83-15835*#** Communications Satellite Corp., Clarksburg, Md
**SILICON RESEARCH AND TECHNOLOGY**
A. MEULENBERG *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 259-263 1982
Avail: NTIS HC A12/MF A01 CSCL 10A

The development of solar cells suitable for space applications are discussed, along with the advantages and disadvantages of silicon and gallium arsenide solar cells The goal of a silicon solar cell with 18% efficiency has not been reached and does not appear promising in the near future L.F.M.

**N83-15836*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**GAAS SOLAR CELLS**
E. J. CONWAY *In* NASA. Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol p 265-266 1982
Avail: NTIS HC A12/MF A01 CSCL 10A

The major thrusts proposed for GaAs were increased efficiency and improved radiation damage data. Current laboratory production cells consistently achieve 16 percent AMO one-Sun efficiency The user community wants 18-percent efficient cells as soon as possible, and such a goal is though to be achievable in 2 years with sufficient research funds A 20-percent research cell is considered the efficiency limit with current technology, and such a cell seems realizable in approximately 4 years. Future efficiency *improvements await improved substrates and materials. For still* higher efficiencies, concentrator cells and multijunction cells are proposed as near-term directions L.F.M.

**N83-15837*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**RADIATION DAMAGE**
I. WEINBERG *In its* Space Photovoltaic Res and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 267-268 1982
Avail· NTIS HC A12/MF A01 CSCL 10A

The radiation damage workshop considered a variety of topics among which were the need for equivalent electron fluences in gallium arsenide, the possibility of 15 percent end-of-life efficiencies for silicon, increasing radiation resistance in gallium arsenide, annealing of radiation damage and the need for radiation damage studies in cascade cells. The workshop members agreed that a high priority should be assigned to obtaining equivalent electron fluences for gallium arsenide cells. It was suggested that 1 MeV would be a reasonable electron energy for this purpose Special care should be given to proton irradiations particularly for energies below 1 MeV. In addition, omnidirectional rather than normal incidence protons should be used. It was also agreed that there was a need for obtaning damage coefficients in gallium arsenide. In silicon, there is a requirement for additional flight data, especially in proton dominated orbits. These data are needed to further check the accuracy of the 1 MeV equivalence fluences L.F.M.

**N83-15838*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena
**BLANKET TECHNOLOGY**
J. SCOTT-MONCK *In* NASA Lewis Research Center Space Photovoltaic Res. and Technol. 1982: High Efficiency, Radiation Damage, and Blanket Technol. p 269-272 1982
Avail· NTIS HC A12/MF A01 CSCL 10A

It was concluded that systems requirements would force a reassessment of the conventional approach to interconnecting cells into blanket or array modules Defense applications (hardening) were identified as the key requirement that would force a movement away from the standard method (solder) of forming array circuits. The panel also agreed that requirements associated with the impending NASA Space Station and in-bound missions would lead to alternative interconnecting approaches. It was concluded that

the diverse requirements of future space missions (high temperature and extended thermal cycling) might not be met by one approach, such as parallel-gap resistance welding. The panel suggested that other options such as high temperature solders and brazing be considered for the various mission requirements that were anticipated. The panel agreed that blanket technology was potentially suitable for in-orbit annealing to temperatures of 200 C provided that conventional soldered connecting techniques were replaced by 'welding'. L.F.M.

**N83-15840*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE WORLDWIDE MARKET FOR PHOTOVOLTAICS IN THE RURAL SECTOR**
W. A. BRAINARD 1982 15 p *refs* *Presented at 16th* Photovoltaic Specialists Conf., San Diego, Calif., 27-30 Sep. 1982; *sponsored by* IEEE
(Contract DE-AI01-79ET-20485)
(NASA-TM-83035; E-1473; DOE/NASA/20485-13; NAS 1.15.83035) Avail: NTIS HC A02/MF A01 CSCL 10A

The worldwide market for stand-alone photovoltaic power systems in three specific segments of the rural sector were determined. The worldwide market for photovoltaic power systems for village power, cottage industry, and agricultural applications were addressed. The objectives of these studies were to: The market potential for small stand-alone photovoltaic power system in specific application areas was assessed Technical, social and *institutional barriers to PV utilization were identified. Funding* sources available to potential users was also identified and marketing strategies appropriate for each sector were recommended to PV product manufacturers. The studies were prepared on the basis of data gathered from domestic sources and from field trips to representative countries. Both country-specific and sector-specific results are discussed, and broadly applicable barriers pertinent to international marketing of PV products are presented. S.L.

**N83-15865*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DIRECT CONVERSION OF INFRARED RADIANT ENERGY FOR SPACE POWER APPLICATIONS Final Report**
R. C FINKE *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol 2 22 p 1982
Avail: NTIS HC A99/MF A01

A *proposed technology to convert the earth radiant energy* (infrared albedo) for spacecraft power is presented. The resultant system would eliminate energy storage requirements and simplify the spacecraft design. The design and performance of a infrared rectenna is discussed. M.G.

**N83-15868*#** Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
**INTERACTION BETWEEN THE SPS SOLAR POWER SATELLITE SOLAR ARRAY AND THE MAGNETOSPHERIC PLASMA Final Report**
J. W. FREEMAN *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 18 p 1982 refs
(Contract NAS8-33023)
Avail: NTIS HC A99/MF A01

The results of study to determine the effects of space plasmas on a large GaAs solar cell array using solar reflectors at a *concentration ratio of two in geostationary orbit are summarized.* It was concluded that the system could function in the GEO environment if certain design changes were implemented These included conductive coatings on the solar cells, changing the reflector material from Kapton to a higher conductivity material, and oversizing the array to compensate for a 0.7% parasitic load due to losses from the ambient magnetospheric plasma. The operation of the solar powered earth orbit transfer vehicle (EOTV) was also examined and it was concluded that LEO servere arcing would take place on all high voltage negative portions of the array. The parasitic load loss at LEO was estimated at 3%. Operation of a high voltage array at LEO represents a major problem. Charge exchange ion feedback from argon ion thrusters located near the EOTV solar array was also examined and all problems found were believed to be solvable by the placement of protective ground screens. M.G.

**N83-15899#** Army Construction Engineering Research Lab., Champaign, Ill. Energy Systems Div.
***OVERVIEW OF PASSIVE SOLAR DESIGN TECHNIQUES Final Report***
D. M. JONCICH Sep. 1982 43 p refs
(AD-A119993; CERL-SR-E-179) Avail: NTIS HC A03/MF A01 CSCL 13A

This report presents an overview of the fundamental terminology, concepts, and techniques related to passive solar technology, and provides examples of passive strategies which can be incorporated into the inventory of Army buildings. GRA

**N83-15902#** Naval Weapons Center, China Lake, Calif.
**FLAT PLATE PHOTOVOLTAIC POWER SYSTEMS: DESCRIPTION, DESIGN AND COST**
M. R. HALL, G. D. SMITH, and D. L. HOLMES Jul. 1982 121 p refs
(AD-A120814; NWC-TP-6381) Avail: NTIS HC A06/MF A01 CSCL 10B

The Energy Program Office at the Naval Weapons Center has *been tasked to manage the Department of the Navy's photovoltaic* effort. This effort includes participation in the Federal Photovoltaic Utilization Program (FPUP), which is sponsored by the Department of Energy, and encouragement of worldwide Navy activities to use Navy funds to procure cost-effective photovoltaic power systems. This report describes in simple nontechnical terms what photovoltaic power systems are, how they are sized, their costs, and their advantages and disadvantages. It also includes all tables and information necessary for the nontechnical person to determine preliminary sizes and costs of photovoltaic power systems for most applications. Navy activities can identify cost-effective applications for photovoltaic power systems by using this report and can procure the systems on their own or seek assistance from the Energy *Program Office. The Energy Program Office will assist in preparing* procurement specifications, evaluating proposals, awarding and monitoring contracts, and acceptance-testing the systems.
Author (GRA)

**N83-15904#** *Air Force Academy, Colo.*
**SIMPLIFIED SOLAR FRACTION ESTIMATION FOR SPACE AND WATER HEATING AT DEPARTMENT OF DEFENSE INSTALLATIONS. APPENDIX C: WATER HEATING NOMOGRAPHS Final Report**
N. S. PACHECO, D. G. KNIOLA, J. F. SHEEDY, and R. J. SCARI Sep. 1982 201 p refs
(AD-A120014; USAFA-TR-82-6-APP-C) Avail: NTIS HC A10/MF A01 CSCL 13A

This report contains a set of nomographs which can be used to estimate the average annual solar fraction for solar space and water heating at a large number of DOD facilities. The solar fraction estimated from the nomograph is in close agreement with F-Chart 3.0 and allows for variation of the following parameters: annual load, collector area, collector transmittance-absorptance coefficient, and collector overall loss coefficient. GRA

**N83-15905#** Air Force Academy, Colo.
**SIMPLIFIED SOLAR FRACTION ESTIMATION FOR SPACE AND WATER HEATING AT DEPARTMENT OF DEFENSE INSTALLATIONS. APPENDIX B: SPACE HEATING NOMOGRAPHS Final Report**
N. S. PACHECO, D. G. KNIOLA, J. F. SHEEDY, and R. J. SCARI Sep. 1982 205 p refs
(AD-A120013; USAFA-TR-82-6-APP-B) Avail: NTIS HC A10/MF A01 CSCL 13A

This report contains a set of nomographs which can be used to estimate the average annual solar fraction for solar space and

water heating at a large number of DOD facilities. The solar fraction estimated from the nomograph is in close agreement with F-Chart 3 0 and allows for variation of the following parameters: annual load, collector area, collector transmittance-absorptance coefficient, and collector overall loss coefficient. GRA

**N83-15906#** Air Force Academy, Colo.
**SIMPLIFIED SOLAR FRACTION ESTIMATION FOR SPACE AND WATER HEATING AT DEPARTMENT OF DEFENSE INSTALLATIONS Final Report**
N. S. PACHECO, D. G. KNIOLA, J. F. SHEEDY, and R J. SCARI Sep. 1982 27 p refs
(AD-A120012; USAFA-TR-82-6) Avail: NTIS HC A03/MF A01 CSCL 13A

This report contains a set of nomographs which can be used to estimate the average annual solar fraction for solar space and water heating at a large number of DOD facilities The solar fraction estimated from the nomograph is in close agreement with F-Chart 3.0 and allows for variation of the following parameters. annual load, collector area, collector transmittance absorption coefficient, and collector overall loss coefficient GRA

**N83-15922#** Bendix Corp , Sylmar, Calif. Energy, Environment and Technology Office.
**DESCRIPTION OF THE 3 MW SWT-3 WIND TURBINE AT SAN GORGONIO PASS CALIFORNIA**
S. C. RYBAK *In* Midwest Res. Inst Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 193-206 1981
Avail: NTIS HC A23/MF A01

Thw SWT-3 wind turbine is a microprocessor controlled three bladed variable speed upwind machine with a 3MW rating that is presently operational and undergoing system testing. The tower, a rigid triangular truss configuration, is rotated about its vertical axis to position the wind turbine into the prevailing wind. The blades rotate at variable speed in order to maintain an optimum 6·1 tip speed ratio between cut in and rated wind velocity thereby maximizing power extraction from the wind. Rotor variable speed is implemented by the use of a hydrostatic transmission consisting of fourteen fixed displacement pumps operating in conjunction with eighteen variable displacement motors. Full blade pitch with on-off hydraulic actuation is used to maintain 3MW of output power between rated wind velocity of 40 mph and the cut-out wind velocity of 55 mph. S.L.

**N83-15924#** United Technologies Research Center, East Hartford, Conn.
**DOE/UTRC KW DEVELOPMENT PROGRAM**
M. C. CHENEY *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 257-270 1981 refs
Avail: NTIS HC A23/MF A01

A 15 kW wind turbine for farm and industrial applications was developed. The design represented an extension of the 8 kW bearingless rotor wind turbine. However, several modifications were incorporated to improve the producibility, reduce costs, and improve the appearance and operating characteristics. These consisted of an integrated transmission to eliminate a separate support frame, the use of a single off the shelf turret bearing replacing the twin bearing yaw assembly, and replacing the guyed tower with a free standing tapered tower. The prototype machine has a diameter of 48 ft and uses a single phase induction generator rated at 23 kW. The hub height is 55 ft. The measured power output at the UTRC test site has been 6 kW at 5.4 m/s (12 mph) and 15 kW at 9 m/s (20 mph). The energy capture at 5.4 m/s is estimated to be 54,850 kWh. S.L.

**N83-15942#** Sandia Corp., Albuquerque, N. Mex.
**SOL-GEL PROTECTIVE COATINGS FOR BLACK CHROME SOLAR SELECTIVE FILMS**
R. B. PETTIT and C. J. BRINKER 1981 18 p refs Presented at SPIE Optical Coatings for Energy Efficiency and Solar Appl. Conf., Los Angeles, Calif., 25 Jan. 1982
(Contract DE-AC04-76DP-00789)
(DE82-004138; SAND-81-1889C; CONF-820107-1) Avail: NTIS HC A02/MF A01

Electrodeposited black chrome solar selective films degrade rapidly when heated to temperatures above 300 C in air. The application of sol-gel protective coatings to the black chrome films was investigated as a possible means to improve the oxidation resistance of black chrome at high temperatures. The sol-gel coating process consists of applying an alcoholic solution containing polymeric glass precursors After the coating is fired for about one-half hour at a moderate temperature (approximately 450 C), a glass layer is obtained. Because of the wide range of sol-gel processing parameters, initial studies concentrated on determining the effect of the following variables on the thermal stability of sol-gel coated black chrome: sol-gel composition; firing temperature; firing atmosphere; sol-gel coating thickness; and pre-aging of the black chrome films. Of the compositions studied, only SiO2/B2O3 and SiO2/B2O3/Na2O/BaO resulted in improved thermal stability R J F.

**N83-15953#** Sandia Labs., Albuquerque, N. Mex.
**LIFETIME AND EFFECTIVE SURFACE RECOMBINATION VELOCITY MEASUREMENTS IN HIGH-EFFICIENCY SI SOLAR CELLS**
B. H. ROSE 1981 4 p refs Presented at the Intern. Electron Devices Meeting, Washington, D. C., 7 Dec 1981
(Contract DE-AC04-76DP-00789)
(DE81-030361; SAND-81-2090C; CONF-811207-1) Avail: NTIS HC A02/MF A01

A conventional analysis method, based on minority carrier diffusion in a solar cell base, is used to obtain bulk lifetime (tau) and effective back-surface recombination velocity (S) from measurements of asymptotic decay times of short-circuit current and open circuit voltage. Since the decay times depend individually on both S and tau, it is necessary to use both current and voltage data for unique results. Experimental measurements of current and voltage transients are presented from variable base resistivity cells, irradiated cells and cells with intentionally damaged back surface field regions. These cells exhibit lifetimes from one to several hundred microseconds and recombination velocities from 100 to 5000 cm/sec. All features of the data are accounted for by the analysis. DOE

## 03

## HYDROGEN

Includes hydrogen production, storage, and distribution.

**A83-11794*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CATALYTIC AUTOTHERMAL REFORMING INCREASES FUEL CELL FLEXIBILITY**
M. FLYTZANI-STEPHANOPOULOS and G. E. VOECKS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Energy Progress, vol. 1, Dec. 1981, p 52-58 refs
(Contract ET-78-A-03-2042)

Experimental results are presented for the autothermal reforming (ATR) of n-hexane, n-tetradecane, benzene and benzene solutions of naphthalene. The tests were run at atmospheric pressure and at moderately high reactant preheat temperatures in the 800-900 K range. Carbon formation lines were determined for paraffinic and aromatic liquids. Profiles were determined for axial bed temperature and composition Space velocity efforts were

assessed, and the locations and types of carbon were recorded. Significant reactive differences between hydrocarbons were identified. Carbon formation characteristics were hydrocarbon specific The differing behavior of paraffinic and aromatic fuels with respect to their carbon formation may be important in explaining the narrow range of carbon-free operating conditions found in the ATR of number two fuel oil. S.C.S.

**A83-12295**
**PARTICLE SIZE DISTRIBUTION OF NI MICROPRECIPITATES IN LANI5 USED FOR HYDROGEN STORAGE**
R L. COHEN, R. C. SHERWOOD, and K. W. WEST (Bell Telephone Laboratories, Inc , Murray Hill, NJ) Applied Physics Letters, vol. 41, Nov. 15, 1982, p. 999-1001. refs

LaNi5 is an intermetallic compound which absorbs and desorbs hydrogen at convenient temperatures and pressures. It has been used for storing hydrogen fuel, and, using the heat of absorption, for various pump and heat engine applications. Recurrent absorption and desorption of hydrogen produces a phase separation into nickel metal and lanthanum hydride. It is shown, from the magnetic behavior of degraded LaNi5, that a bimodal particle size distribution is present with all particles smaller than 100 cubic angstroms. The magnetic properties may be useful for determining the condition of LaNi5 in a reservoir. (Author)

**A83-12508*#** Michigan State Univ., East Lansing.
**MEASUREMENTS OF ENERGY DISTRIBUTION AND THRUST FOR MICROWAVE PLASMA COUPLING OF ELECTRICAL ENERGY TO HYDROGEN FOR PROPULSION**
T. MORIN, R. CHAPMAN, J FILPUS, M HAWLEY, R. KERBER, J. ASMUSSEN (Michigan State University, East Lansing, MI), and S. NAKANISHI (NASA, Lewis Research Center, Cleveland, OH) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov 17-19, 1982, AIAA 12 p.
(AIAA PAPER 82-1951)

A microwave plasma system for transfer of electrical energy to hydrogen flowing through the system has potential application for coupling energy to a flowing gas in the electrothermal propulsion concept. Experimental systems have been designed and built for determination of the energy inputs and outputs and thrust for the microwave coupling of energy to hydrogen. Results for experiments with pressure in the range 100 microns-6 torr, hydrogen flow rate up to 1000 micronmoles/s, and total absorbed power to 700 w are presented (Author)

**A83-16041**
**OPERATION OF A STEADY-STATE PH-DIFFERENTIAL WATER ELECTROLYSIS CELL**
O. TESCHKE and M. G. ZWANZIGER (Campinas, Universidade Estadual, Campinas, Sao Paulo, Brazil) International Journal of Hydrogen Energy, vol. 7, no 12, 1982, p 933-937. refs

The design features and experimental results with a steady-state electrolysis cell using an acid pH at the cathode and a basic condition at the anode are described. The differential pH concentrations were configured to obtain water decomposition voltages lower than the nominal 1.23 V at 1 atm and 25 C. Oxygen evolution occurs 0.8 V less anodic at a pH of 14 than at a pH of 0, while lower voltage is needed for hydrogen evolution in an acidic solution. The pH differential was set up with an external water feed in the test cell The anode and cathode were positioned on either side of a solid polymer electrolyte sheet. The trials were run with pure water in circulating, closed systems, with KOH in a closed system, and with KOH in a circulating system. Lowered electricity consumption was demonstrated, although none of the configurations showed a favorable energy balance. M.S K.

**A83-16042**
**PRODUCTION OF HYDROGEN BY DIRECT THERMAL DECOMPOSITION OF WATER - PRELIMINARY INVESTIGATIONS**
J. LEDE, F. LAPICQUE, J. VILLERMAUX (CNRS, Laboratoire des Sciences du Genie Chimique, Nancy, France), B. CALES, A. OUNALLI, J. F. BAUMARD, and A. M. ANTHONY (CNRS, Centre de Recherches sur la Physique des Hautes Temperatures, Orleans, France) International Journal of Hydrogen Energy, vol. 7, no. 12, 1982, p. 939-950. Research supported by the Centre National de la Recherche Scientifique. refs

Preliminary results from examinations of two techniques to effect solar thermal decomposition of water and then prevent recombination, as part of the French PIRDES program, are reported. A solar furnace simulator was fabricated with a 4 kW lamp shining light on elliptic mirrors which redirected the light to a focus to produce temperatures of 3000 K. Reaction studies have shown that significant hydrogen evolution occurs only at temperatures above 2000 K. Water injected into a zirconia nozzle at the focus rose to 2300 K and began dissociating within 0.001-0.01 sec. One experiment comprised water vapor with argon gas, pure water, and two types of nozzles (one perforated). Evolved hydrogen increased with increased stirring of the water feed, but decreased with increasing flow rate Use of membrane semipermeable to oxygen around the zirconia nozzle demonstrated that the hydrogen flow rate depended on the electrical characteristics of the membrane. Good agreement was found between theoretical predictions and the hydrogen evolution rates in all the configurations. M.S.K

**A83-16044**
**HYDROGEN AS A VECTOR FOR CENTRAL RECEIVER SOLAR UTILITIES**
E. BILGEN (Exergy Research Corp., Montreal, Canada) and C BILGEN (Exergy Research Corp , Montreal, Canada) International Journal of Hydrogen Energy, vol. 7, no 12, 1982, p. 977-984 Research supported by the Central Mortgage and Housing Corp. refs

The production of hydrogen and hydrogen-rich fuels from water and raw petroleum and gas products by means of a central receiver solar utility plant is examined. The fuels produced would be employed for both industrial and domestic purposes. The latter is also considered as a market for the low-grade heat with small heliostat-central receiver configurations. The total system efficiencies for conversion of solar radiation to heat are calculated, as are the thermodynamic balances of water decomposition. Attention is given to the hybrid sulfuric acid, sulfuric acid-hydrogen bromide, and the sulfuric acid-hydrogen iodine cycles, noting that the last has an overall thermal efficiency of 50 percent. An initial outline of a solar hydrogen plant is provided, indicating annual hydrogen production costs of $18.2/GJ for a thermomechanical process and $20.7/GJ for a solar thermal electrolysis process in the 1990s. M.S.K.

**N83-10501*** National Aeronautics and Space Administration. Pasadena Office, Calif.
**THERMAL REACTOR Patent**
H. LEVIN (JPL, California Inst. of Technology, Pasadena) and L. B. FORD, inventors (to NASA) (JPL, California Inst. of Technology, Pasadena) 29 Feb. 1980 9 p Filed 29 Feb. 1980 Supersedes N80-20338 (80 - 11, p 1389) Sponsored by NASA
(NASA-CASE-NPO-14369-1; US-PATENT-4,343,772; US-PATENT-APPL-SN-126063; US-PATENT-CLASS-422-200; US-PATENT-CLASS-422-202; US-PATENT-CLASS-422-224; US-PATENT-CLASS-55-204) Avail: US Patent and Trademark Office CSCL 10A

A thermal reactor apparatus and method of pyrolyticaly decomposing silane gas into liquid silicon product and hydrogen by-product gas is disclosed. The thermal reactor has a reaction chamber which is heated well above the decomposition temperature of silane. An injector probe introduces the silane gas tangentially into the reaction chamber to form a first, outer, forwardly moving vortex containing the liquid silicon product and a second, inner,

rewardly moving vortex containing the by-product hydrogen gas. The liquid silicon in the first outer vortex deposits onto the interior walls of the reaction chamber to form an equilibrium skull layer which flows to the forward or bottom end of the reaction chamber where it is removed. The by-product hydrogen gas in the second inner vortex is removed from the top or rear of the reaction chamber by a vortex finder. The injector probe which introduces the silane gas into the reaction chamber is continually cooled by a cooling jacket Official Gazette of the U S. Patent and Trademark Office

**N83-10560*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**COMBUSTION CHARACTERISTICS OF HYDROGEN. CARBON MONOXIDE BASED GASEOUS FUELS**
*J. J. NOTARDONATO, D. J WHITE (Solar Turbines Inc.)*, A J. KUBASCO (Solar Turbines Inc.), and R. T. LECREN (Solar Turbines Inc.) 21 Oct. 1981 16 p refs Presented at the Joint Power Conf., Denver, 17-21 Oct. 1982
(Contract DE-AI01-77ET-13111)
(NASA-TM-82998; E-1434; NAS 1 15 82998, DOE/NASA/13111-13) Avail: NTIS HC A02/MF A01 CSCL 21D

An experimental rig program was conducted with the objective of evaluating the combuston performance of a family of fuel gases based on a mixture of hydrogen and carbon monoxide. These gases, in addition to being members of a family, were also representative of those secondary fuels that could be produced from coal by various gasification schemes. In particular, simulated Winkler, Lurgi, and Blue-water low and medium energy content gases were used as fuels in the experimental combustor rig. The combustor used was originally designed as a low NOx rich-lean system for burning liquid fuels with high bound nitrogen levels. When used with the above gaseous fuels this combustor was operated in a lean-lean mode with ultra long residence times. The Blue-water gas was also operated in a rich-lean mode. The results of these tests indicate the possibility of the existence of an 'optimum' gas turbine hydrogen - carbon monoxide based secondary fuel. Such a fuel would exhibit NOx and high efficiency over the entire engine operating range It would also have sufficient stability range to allow normal light-off and engine acceleration. Solar Turbines Incorporated would like to emphasize that the results presented here have been obtained with experimental rig combustors. The technologies generated could, however, be utilized in future commercial gas turbines. B.W.

**N83-12206#** Oak Ridge National Lab., Tenn. Chemical Technology Div.
**PHOTOSYNTHETIC WATER SPLITTING Annual Report, Jan. - Dec. 1981**
E. GREENBAUM Jan. 1982 21 p refs
(Contract GRI-5080-361-0368)
(PB82-200684, GRI-81/0036; ORNL/TM-8320) Avail: NTIS HC A02/MF A01 CSCL 07D

The basic physics and chemistry of photosynthetic hydrogen and oxygen production are examined During this reporting period, the first measurements of the turnover times and photosynthetic unit sizes of steady state simultaneous photoproduction of hydrogen and oxygen have been determined. The results for the turnover times are encouraging because they demonstrate that the values for the hydrogen and oxygen photoreactions are kinetically compatible and are about the same as the turnover times for normal photosynthesis. The major limiting aspect of the hydrogen and oxygen photoreactions is the number of apparent functional photosynthetic units. Studies on the long-term stability and endurance of hydrogen and oxygen photoproduction in anaerobically adapted green algae have also been performed. Preliminary results indicate that these organisms are extremely rugged and may be of eventual use in practical applications. GRA

**N83-13276#** Department of Energy, Washington, D. C. Office of the Assistant Secretary for Conservation and Renewable Energy
**SUMMARY OF DOE HYDROGEN PROGRAM FY-1981 BY THE HYDROGEN ENERGY COORDINATING COMMITTEE**
Jul. 1982 52 p
(DE82-020494; DOE/CE-034) Avail: NTIS HC A04/MF A01

Hydrogen, as an energy storage medium and as a general purpose fuel is emphasized. The production storage, and use of hydrogen as a mobile fuel, as a stationary fuel, as a fuel feedstock, or as a chemical feedstock is studied, individual elements of the hydrogen program are described. DOE

**N83-13593#** Teledyne Energy Systems, Timonium, Md.
**ADVANCED ALKALINE ELECTROLYSIS CELL DEVELOPMENT. DEVELOPMENT OF ELECTROLYSIS OPERATION CELL SEPARATOR FOR 1250C Summary Report**
J. N. MURRAY Apr. 1982 126 p refs Prepared for Brookhaven National Lab., Upton, N.Y.
(Contract DE-AC02-76CH-00016)
(DE82-020697, BNL-51573) Avail: NTIS HC A07/MF A01

The development of an electrode separator that will allow continuous water electrolysis at 1250C is described. This separator has nearly identical mechanical characteristics relative to the existing commercial asbestos separator which appears to be limited chemically to operation below 900C. Additional insight into the requirements for an improved anode structure and progress in anode improvements is also discussed. The reporting requirements for participation as part of the International Energy Agency hydrogen production research and development program are included. DOE

**N83-14204#** Spectron Development Labs., Inc., Costa Mesa, Calif.
**PARTICULATE PROCESSES IN PULVERIZED COAL FLAMES Quarterly Technical Progress Report, Apr. - Oct. 1981**
30 Oct. 1981 56 p refs
(Contract DE-AC22-80PC-30300)
(DE82-003370; DOE/PC/30300/T4) Avail: NTIS HC A04/MF A01

The experiment plan, the design and fabrication of the 2 color pyrometer system, and the conduct and assessment of preliminary observations of ignition and devoltalization are described. The fabrication and assembly of the furnace was completed. Initial checkout and characterization runs are in progress. The interfacing of the instrumentation with the experiment is also in progress. Experimental observations of ignition and devolatilization of Pittsburgh Seam HVA bituminous coal were initiated. Observations using both front and back light pulsed laser holography and particle sizing interferometry were made. Experiments were completed using both 80 micron and 15 micron particles. Analysis of the data holograms indicate that high quality resolution has been achieved, which will allow the observation of detail not heretofore achieved. DOE

**N83-14303#** Brookhaven National Lab., Upton, N. Y
**HYDROGEN RECOVERY FROM SUPPLEMENTED NATURAL GAS BY METAL HYBRIDES**
D. T. J. HUANG, F. REIDINGER, and F. B. HILL 1981 7 p refs Presented at the Ann. Contractors' Rev. Meeting on Thermal and Chem. Storage, Tysons Corner, Va., 16 Sep. 1981
(Contract DE-AC02-76CH-00016)
(DE82-002245; BNL-30057; CONF-810940-28) Avail: NTIS HC A02/MF A01

A metal hydride process employing LaNi4 7Al0 3 for recovery of hydrogen from supplemented natural gas is discussed. Experimental studies involved determination of the equilibrium hydrogen capacity of the alloy, measurement of the adsorption behavior of contaminant gases, and measurement of rates of hydrogen absorption by the alloy. The results were used as the basis for a preliminary process design and cost estimate DOE

**N83-15958#** Los Alamos Scientific Lab., N. Mex.
**USE OF OXIDE DECOMPOSITIONS IN ADVANCED THERMOCHEMICAL HYDROGEN CYCLES FOR SOLAR HEAT SOURCES. EXPERIMENTAL RESULTS ON THE LOW-TEMPERATURE REACTIONS FOR THE TRICOBALT TETRAOXIDE-COBALT MONOXIDE PAIR**
W. M. JONES and M. G. BOWMAN 1982 9 p refs Presented at the World Hydrogen Energy Conf., Pasadena, Calif., 13-17 Jun. 1982
(Contract W-7405-ENG-36)
(DE82-002390; LA-UR-81-2927; CONF-820605-3) Avail: NTIS HC A02/MF A01

The concept of utilizing oxide decompositions in advanced thermochemical hydrogen cycles for solar heat sources is introduced. It has particular interest in allowing direct transmission of energy to the process through an air window. A cycle for the Co3O4-CoO pair would be, schematically: (1) Co3O4 = 3CoO + 1/2 O2; (2) I2(s,1) + Mg(OH)2 + 3CoO = MgI2(aq) + Co3O4 + H2O(1); (3)H20 + MgI2(aq) = MgO + 2HI; (4)2 HI = H2 + I2; (5) MgO + H2O = Mg(OH)2. Reaction (2) should give a high concentration of MgI2 that would be favorable for (3). The solutions would also contain iodine dissolved as polyiodide, partly offsetting this advantage. Preliminary results are indicated. DOE

**N83-16153*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ANALYSIS OF COMBUSTION SPECTRA CONTAINING ORGAN PIPE TONE BY CEPSTRAL TECHNIQUES**
J. H. MILES and C. A. WASSERBAUER 1982 29 p refs Presented at the 104th Meeting of the Acoustical Soc. of Am., Orlando, Fla., 8-12 Nov. 1982
(NASA-TM-83034; E-1472; NAS 1.15:83034) Avail: NTIS HC A03/MF A01 CSCL 20A

Signal reinforcements and cancellations due to standing waves may distort constant bandwidth combustion spectra. Cepstral techniques previously applied to the ground reflection echo problem are used to obtain smooth broadband data and information on combustion noise propagation. Internal fluctuating pressure measurements made using a J47 combustor attached to a 6.44 m long duct are analyzed. Measurements made with Jet A and hydrogen fuels are compared. The acoustic power levels inferred from the measurements are presented for a range of low heat release rate operating conditions near atmospheric pressure. For these cases, the variation with operating condition of the overall acoustic broadband power level for both hydrogen and Jet A fuels is consistent with previous results showing it was proportional to the square of the heat release rate. However, the overall acoustic broadband power level generally is greater for hydrogen than for Jet A. S.L.

# 04

# FUELS AND OTHER SOURCES OF ENERGY

Includes fossil fuels, nuclear fuels, geothermal and ocean thermal energy, tidal energy, and wind energy.

**A83-10030**
**APPLICATIONS OF REMOTE SENSING TO PETROLEUM EXPLORATION**
M. T. HALBOUTY In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1981, p. 305-311. refs

The application of remote sensing using Landsat imagery to petroleum exploration is discussed. It is shown that Landsat imagery can be used effectively to outline sedimentary terrains and to determine the areal distribution of key strata and their relation to regional structure. In addition, it is proposed that the US government undertake a program to develop improved petroleum exploration techniques that are beyond the scope of industry, while also obtaining global energy information which can be used to evaluate energy alternatives and to formulate energy policy, as well as to evaluate areas for exploration. It is recommended that a stereoscopic imaging satellite be flown as soon as possible by NASA in order to acquire global data for analysis of energy related geologic structures. N.B.

**A83-10031*** Arkansas Univ., Fayetteville.
**EXPLORATION FOR FRACTURED PETROLEUM RESERVOIRS USING RADAR/LANDSAT MERGE COMBINATIONS**
H. MACDONALD, W. WAITE, M. BORENGASSER, D. TOLMAN (Arkansas University, Fayetteville, AR), and C. ELACHI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1981, p. 312-317.
(Contract JPL-955048)

Since fractures are commonly propagated upward and reflected at the earth's surface as subtle linears, detection of these surface features is extremely important in many phases of petroleum exploration and development. To document the usefulness of microwave analysis for petroleum exploration, the Arkansas part of the Arkoma basin is selected as a prime test site. The research plan involves comparing the aircraft microwave imagery and Landsat imagery in an area where significant subsurface borehole geophysical data are available. In the northern Arkoma basin, a positive correlation between the number of linears in a given area and production from cherty carbonate strata is found. In the southern part of the basin, little relationship is discernible between surface structure and gas production, and no correlation is found between gas productivity and linear proximity or linear density as determined from remote sensor data. C.R.

**A83-10032*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**REMOTE SENSING AND URANIUM EXPLORATION AT LISBON VALLEY, UTAH**
J. E. CONEL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and P. L. NIESEN (Atlas Corp., Moab, UT) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1981, p. 318-324. refs
(Contract NAS7-100)

As part of the joint NASA-Geosat uranium test case program, aircraft-acquired multispectral scanner data are used to investigate the distribution of bleaching in Windgate sandstone exposed in Lisbon Valley anticline, Utah. It is noted that all of the large ore bodies contained in lower Chinle Triassic age or Cutler Permian age strata in this area lie beneath or closely adjacent to such bleached outcrops. The geographic coincidences reported here are seen as inviting renewed interest in speculation of a causal relation between occurrences of Mississippian-Pennsylvanian oil and gas in this area and of Triassic uranium accumulation and rock bleaching. C.R.

**A83-10041**
**APPLICATIONS OF REMOTE SENSING TO WIND POWER FACILITY SITING**
J. E. WADE, C. L. ROSENFELD, and P. A. MAULE (Oregon State University, Corvallis, OR) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1981, p. 443-448.

A method by which wind energy prospectors can use remote sensing to rapidly examine extensive geographical areas to identify potential wind turbine generators' sites is outlined. Remote sensing in wind prospecting is not being considered as a tool for determining wind power potential but, rather, as an aid in identifying terrestrial, marine, and atmospheric characteristics associated with desirable wind power sites. It is noted that locations with interesting features

noted in a regional assessment can be more closely evaluated using medium-scale imagery, which can be acquired from a number of different agencies, among them the U.S. Forest Service, the Bureau of Land Management, Water and Power Resources and the Soil Conservation Service. Once specific locations have been identified from small- and medium-scale imagery, low-level aerial reconnaissance in a locally chartered aircraft can verify the information obtained. Wind-deformed trees, active slip faces on dunes, snow cornices, snow fences, and the slopes of ridges can be evaluated. C.R.

**A83-10115**
**THE 100 DAYS OF SEASAT-A**
S. W. MCCANDLESS, JR. (*User Systems Engineering, Annandale*, VA) In: International Geoscience and Remote Sensing Symposium, Washington, DC, June 8-10, 1981, Digest. Volume 2 New York, Institute of Electrical and Electronics Engineers, 1981, p. 1401-1406.

The accomplishments of Seasat-A are reviewed. The radar altimeter monitored average wave height to within 0 5 to 1 meter along a 2 to 12 m swath, and measured changes in the ocean geoid to a precision of 10 cm The radar scatterometer measured wind speeds from 3 to 28 m/sec within 2 m/sec and direction within 20 deg over two 500 km swaths. The five-frequency microwave radiometer measured surface temperature by measuring the microwave brightness of the surface to within 1 C, measured foam brightness which can be converted into a measurement of high wind speed, mapped ice coverage, and provided atmospheric correction data to the active radars by measuring liquid and gaseous water content in the upper atmosphere. The Synthetic Aperture Radar provided detailed images of open ocean, coastal, inland geology and culture, and ice-covered regions. Relevant oceanographic satellite applications include offshore oil and gas, environmental forecasting, marine transportation, deep ocean mining, and marine fisheries. C.D.

**A83-10658#**
**DEVELOPING TECHNOLOGIES FOR SYNTHETIC FUELS**
F. B. SPROW (Exxon Research and Engineering Co., Florham Park, NJ) Journal of Energy, vol. 6, Nov.-Dec. 1982, p. 413-417.

(Previously cited in issue 14, p. 2395, Accession no. A81-32907)

**A83-11050*#** Southwest Research Inst., San Antonio, Tex.
**TESTS OF BLENDING AND CORRELATION OF DISTILLATE FUEL PROPERTIES**
J. ERWIN and J. N. BOWDEN (Southwest Research Institute, San Antonio, TX) American Institute of Chemical Engineers, Summer National Meeting, Cleveland, OH, Aug. 29-Sept. 1, 1982, Paper. 38 p.
(Contract NAS3-22783)

The development of a fuel test matrix, results from tests of several blends of distillate aircraft fuels, and the use of correlations in formulation determination during a NASA-sponsored program to identify new aircraft fuels are described. The program was initiated in order to characterize fuel blends which are appropriate for different types of combustors in use and under development. The fuels were required to feature a specified range of properties. Attention is given to fuel volatility, hydrogen content, aromatic content, freezing point, kinematic viscosity, and naphthalene content. Paraffinic and naphtenic base stocks were employed, using alkyl benzene, naphthene benzenes, and naphthalenes to adjust the blend properties. Categories for the test fuels comprised source-controlled and composition controlled fuels. Test results and compositions of various fuels are provided. M.S.K.

**A83-11482*#** Utah Univ., Salt Lake City.
**A CARBON-13 AND PROTON NUCLEAR MAGNETIC RESONANCE STUDY OF SOME EXPERIMENTAL REFEREE BROADENED-SPECIFICATION /ERBS/ TURBINE FUELS**
D. K. DALLING and R. J. PUGMIRE (Utah, University, Salt Lake City, UT) American Institute of Chemical Engineers, Summer National Meeting, Cleveland, OH, Aug. 29-Sept. 1, 1982, Paper. 20 p. refs
(Contract NAG3-27)

Preliminary results of a nuclear magnetic resonance (NMR) spectroscopy study of alternative jet fuels are presented. A referee broadened-specification (ERBS) aviation turbine fuel, a mixture of 65 percent traditional kerosene with 35 percent hydrotreated catalytic gas oil (HCGO) containing 12.8 percent hydrogen, and fuels of lower hydrogen content created by blending the latter with a mixture of HCGO and xylene bottoms were studied The various samples were examined by carbon-13 and proton NMR at high field strength, and the resulting spectra are shown. In the proton spectrum of the 12 8 percent hydrogen fuel, no prominent single species is seen while for the blending stock, many individual lines are apparent. The ERBS fuels were fractionated by high-performance liquid chromatography and the resulting fractions analyzed by NMR. The species found are identified. C.D.

**A83-11491*#** Solar Turbines International, San Diego, Calif.
**COMBUSTION CHARACTERISTICS OF HYDROGEN-CARBON MONOXIDE BASED GASEOUS FUELS**
D. J. WHITE, A. J. KUBASCO, R. T LECREN (Solar Turbines, Inc., San Diego, CA), and J. J. NOTARDONATO (NASA, Lewis Research Center, Cleveland, OH) IEEE, ASME, and ASCE, Joint Power Generation Conference, Denver, CO, Oct 17-21, 1982, Paper. 13 p. Research supported by the U.S. Department of Energy
(Contract DEN3-145)

The results of trials with a staged combustor designed to use coal-derived gaseous fuels and reduce the NO(x) emissions from nitrogen-bound fuels to 75 ppm and 37 ppm without bound nitrogen in 15% O2 are reported. The combustor was outfitted with primary zone regenerative cooling, wherein the air cooling the primary zone was passed into the combustor at 900 F and mixed with the fuel. The increase in the primary air inlet temperature eliminated flashback and autoignition, lowered the levels of CO, unburned hydrocarbons, and smoke, and kept combustion efficiencies to the 99% level The combustor was also equipped with dual fuel injection to test various combinations of liquid/gas fuel mixtures. Low NO(x) emissions were produced burning both Lurgi and Winkler gases, regardless of the inlet pressure and temperature conditions. Evaluation of methanation of medium energy gases is recommended for providing a fuel with low NO(x) characteristics. M.S.K.

**A83-11493*#** Westinghouse Electric Corp., Concordville, Pa.
**NOX RESULTS FROM TWO COMBUSTORS TESTED ON MEDIUM BTU COAL GAS**
T. P. SHERLOCK, D. E. CARL, G. VERMES (Westinghouse Electric Corp., Concordville, PA), J. SCHWAB (Westinghouse Electric Corp., Pittsburgh, PA), and J. J. NOTARDONATO (NASA, Lewis Research Center, Cleveland, OH) IEEE, ASME, and ASCE, Joint Power Generation Conference, Denver, CO, Oct. 17-21, 1982, Paper 9 p.

The results of tests of two combustor configurations using coal gas from a 25 ton/day fluidized bed coal gasifier are reported. The trials were run with a ceramic-lined, staged rich/lean burner and an integral, all metal multiannular swirl burner (MASB) using a range of temperatures and pressures representative of industrial turbine inlet conditions. A lean mixture was examined at 104, 197, and 254 Btu/Scf, yielding NO(x) emissions of 5, 20, and 70 ppmv, respectively. The MASB was employed only with a gas rated at 220-270 Btu/Scf, producing 80 ppmv NO(x) at rated engine conditions. The results are concluded to be transferrable to current machines. Further tests on the effects of gas composition, the scaling of combustors to utility size, and the development of

improved wall cooling techniques and variable geometry are indicated. M.S.K.

**A83-11831*** Lunar and Planetary Inst., Houston, Tex.
**A GROUNDWATER CONVECTION MODEL FOR RIO GRANDE RIFT GEOTHERMAL RESOURCES**
P. MORGAN (Lunar and Planetary Institute, Houston, TX), V. HARDER, P. H. DAGGETT (Texas, University, El Paso, TX), and C. A. SWANBERG (New Mexico State University, Las Cruces, NM) Geothermal Resources Council, Transactions, vol. 5, Oct. 1981, p. 193-196. Research supported by Los Alamos National Laboratory refs
(Contract NASW-3389)

It has been proposed that forced convection, driven by normal groundwater flow through the interconnected basins of the Rio Grande rift is the primary source mechanism for the numerous geothermal anomalies along the rift. A test of this concept using an analytical model indicates that significant forced convection must occur in the basins even if permeabilities are as low as 50-200 millidarcies at a depth of 2 km. Where groundwater flow is constricted at the discharge areas of the basins forced convection can locally increase the gradient to a level where free convection also occurs, generating surface heat flow anomalies 5-15 times background. A compilation of groundwater data for the rift basins shows a strong correlation between constrictions in groundwater flow and hot springs and geothermal anomalies, giving strong circumstantial support to the convection model. (Author)

**A83-11988**
**ENVIRONMENTAL MONITORING OF THE ATHABASCA OIL SANDS USING LANDSAT DATA**
S. ARONOFF, G. A. ROSS, and W. A. ROSS (Calgary, University, Calgary, Alberta, Canada) Photogrammetna, vol. 38, Oct. 1982, p. 77-86. Research supported by the Alberta Oil Sands Environmental Research Program. refs

The Athabasca Oil Sands have undergone rapid and extensive strip mine development. This activity is expected to resume as the cost of petroleum continues to rise. Sixteen spring, summer, and fall Landsat color composite transparencies at the 1/1 million scale were evaluated for use in environmental monitoring. Roads, cleared areas, and water features were best imaged on the May 1, 1976 color composite. Summer Product 8 imagery (July and August) was most useful for vegetation analysis and also had the best year to year signature consistency. For this reason, summer Product 8 imagery was considered most suitable for environmental monitoring of the oil sands region. Two summer images were overlayed and registered, then changes were classified using a supervised classification algorithm. Change detection analyses of open water, cleared land, and vegetation appeared to be the most valuable applications of Landsat digital data to environmental monitoring of the region. (Author)

**A83-12036*** Alaska Univ., Fairbanks.
**RADAR AND INFRARED REMOTE SENSING OF GEOTHERMAL FEATURES AT PILGRIM SPRINGS, ALASKA**
K. G. DEAN, R. B. FORBES, D. L. TURNER, F. D. EATON (Alaska, University, Fairbanks, AK), and K. D. SULLIVAN (NASA, Johnson Space Center, Houston, TX) Remote Sensing of Environment, vol. 12, Nov. 1982, p. 391-405. refs
(Contract NAG9-8)

High-altitude radar and thermal imagery collected by the NASA research aircraft WB57F were used to examine the structural setting and distribution of radiant temperatures of geothermal anomalies in the Pilgrim Springs, Alaska area. Like-polarized radar imagery with perpendicular look directions provides the best structural data for lineament analysis, although more than half the mapped lineaments are easily detectable on conventional aerial photography. Radiometer data and imagery from a thermal scanner were used to evaluate radiant surface temperatures, which ranged from 3 to 17 C. The evening imagery, which utilized density-slicing techniques, detected thermal anomalies associated with geothermal heat sources. The study indicates that high-altitude predawn thermal imagery may be able to locate relatively large areas of hot ground in site-specific studies in the vegetated Alaskan terrain. This imagery will probably not detect gentle lateral gradients.
S.C S.

**A83-12954**
**A DIAGNOSTIC MODEL FOR ESTIMATING WINDS AT POTENTIAL SITES FOR WIND TURBINES**
R. M. ENDLICH, F. L. LUDWIG, C. M BHUMRALKAR (SRI International, Menlo Park, CA), and M. A. ESTOQUE (Miami, University, Miami, FL) Journal of Applied Meteorology, vol. 21, Oct. 1982, p. 1441-1454. refs

A numerical method for estimating the wind power potential of a given site by using terrain heights of the site and of surrounding sites of sources of meteorological data is presented. The technique uses wind and pressure data from four or five National Weather Service stations. An initial estimate is made of winds in the ABL and then adjusted to satisfy the continuity equations, thereby accounting for the influences of terrain and boundary layer height. The model is capable of generating wind speed frequency distributions, monthly variations, diurnal variations, and wind roses, using hourly or three-hourly wind and pressure data The model was used to generate statistics for DoE candidate wind turbine sites for which on-site data were available, using inputs from off-site areal meteorological stations only. Average annual wind speed deviations of 0.7 m/sec were obtained in comparison with the on-site data, an accuracy level suitable for selecting sites to erect wind measuring equipment to obtain at least one year of on-site data. M S.K.

**A83-14056**
**AN EXPERIMENTAL STUDY OF FUEL COMBUSTION IN A HIGH-TEMPERATURE AIR COUNTERFLOW [EKSPERIMENTAL'NOE ISSLEDOVANIE GORENIIA TOPLIV VO VSTRECHNOM VYSOKOTEMPERATURNOM POTOKE VOZDUKHA]**
IU. M. ANNUSHKIN, A. N. KNIAZEV, and N. S. LOSHENKOVA Fizika Goreniia i Vzryva, vol. 18, Sept.-Oct. 1982, p. 55-58. In Russian. refs

The geometrical characteristics of evaporation zones and flame jets during the combustion of hydrocarbon and boron-hydrocarbon fuels atomized into an oncoming high-temperature air flow are investigated experimentally over a wide range of dynamic pressures and thermal powers of the burner. Possible differences in the combustion mechanisms of the fuels studied are discussed. V.L.

**A83-14120**
**PRIMARY ENERGY: PRESENT STATUS AND FUTURE PERSPECTIVES**
K. O. THIELHEIM, (ED.) (Kiel, Neue Universitaet, Kiel, West Germany) Berlin, Springer-Verlag, 1982. 379 p. $34.

A survey of the base-load energy sources available to humans is presented, starting from the point of view that all energy used is ultimately derived from nuclear processes within the sun. Specific note is made of European energy options, noting the large dependence on imported oil. Detailed exploration of available nuclear fuel resources is carried out, with attention given to fission, fusion, and breeder reactor plants and to the state-of-the-art and technology for each. The problems of nuclear waste disposal are discussed, and long term burial in salt domes is outlined as a satisfactory method of containing the materials for acceptable periods of time. The CO2-greenhouse effect hazards caused by increased usage of coal-derived fuels are considered and precautions to be taken on a global scale to ameliorate the warming effects are recommended. The limitations to hydropower are examined, as are those of tidal power. Solar cells are projected to be produced in GW quantities by the year 2000, while wind-derived electricity is predicted to provide a minimum of 5% of the world energy needs in the future. M.S.K.

A83-14238#
**ENVIRONMENTAL MONITORING OF THE ATHABASCA OIL SANDS REGION**
S. ARONOFF (California, University, Berkeley, CA), G. A. ROSS, and W. A. ROSS (Calgary, University, Calgary, Alberta, Canada) In: Canadian Symposium on Remote Sensing, 7th, Winnipeg, Canada, September 8-11, 1981, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1982, p. 100-109. Research supported by the Canada Centre for Remote Sensing, Alberta Oil Sands Environmental Research Program, and TES Research and Consulting, Ltd. refs

This study was designed to examine the application of remote sensing to environmental monitoring of the 30,000 square km region under the jurisdiction of the Alberta Oil Sands Environmental Research Program (AOSERP) and to demonstrate appropriate ways to integrate field-acquired and remotely-sensed data. False color infrared aerial photography acquired during the period of maximum foliage development was found to be most valuable for vegetation mapping and the detection of environmental disturbance. Thermal infrared night-time imagery, used with true color aerial photography, was found to be most valuable in the detection of thermal anomalies related to water features and in the analysis of oil sands plant sites. Landsat color composite transparencies were found to be valuable in providing an overview of the major ecological communities in the area, and of the progress of land-clearing operations. Digital analysis of two summer images was done using the computer-based image analysis system at the Canada Centre for Remote Sensing in Ottawa. Change detection analysis of open water, cleared land, and vegetation appeared to be the most valuable application of Landsat digital data to environmental monitoring of the region (Author)

A83-14256#
**LANDSAT FOR RESOURCE EVALUATION AND MANAGEMENT IN THE ALBERTA FOOTHILLS**
D. B. V. R. CLAASEN and G. A. ROSS (Calgary, University, Calgary, Alberta, Canada) In: Canadian Symposium on Remote Sensing, 7th, Winnipeg, Canada, September 8-11, 1981, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1982, p. 247-263. Research supported by Gulf Canada Resources, Inc. refs

The operational role of Landsat imagery in the integrated resource survey process in Alberta has been evaluated noting that oil and gas exploration is a major land use project in the Alberta foothills. Premapping is discussed with reference to imagery selection and enhancement. Reconnaissance field work is described and analysis-mapping procedures are outlined in terms of: (1) the visual analysis of standard color composite images; (2) ecodistrict stratification on enhanced imagery; (3) terrain condition indicators; (4) the Landsat biophysical unit; and (5) biophysical unit mapping. S.C.S

A83-14669#
**THE AVAILABILITY OF WIND ENERGY IN HONG KONG**
C. T. LEUNG (Chinese University of Hong Kong, Hong Kong) Regional Journal of Energy, Heat and Mass Transfer, vol. 4, Oct. 1982, p. 229-237. refs

A83-15841#
**AN EXPERIMENTAL STUDY AND MODELING OF HEAT TRANSFER IN BOILERS OF SMALL AND MEDIUM POWER [ETUDE EXPERIMENTALE ET MODELISATION DES ECHANGES THERMIQUES DANS LES CHAUDIERES DE PETITES ET MOYENNES PUISSANCES]**
J.-P. GIRARD Lyon, Institut National des Sciences Appliquees, Docteur-Ingenieur Thesis, 1981. 131 p. In French. refs

An experimental boiler is constructed which allows the measurement of heat transfer between the gas and thy boiler, the determination of the temperature in the combustion chamber, and the analysis of the gas in the combustion chamber. The investigations are performed for domestic fuel oil and natural gas, and can be utilized to study the influence of different burner configurations and the operating conditions on the heat transfer and the yield of the boiler. The experimental results are used to develop a theoretical model for determining the heat flux exchanged in the combustion chamber and the smoke-heat exchanger The model indicates the importance of the diameter of the boiler in the heat exchange, the lesser importance of the length of the flame and the emissivity of the wall, and the negligible importance of the temperature of the wall. N.B.

A83-16736#
**REMOTE SENSING OF COAL-FIRED MHD BY OPTICAL DIAGNOSTIC TECHNIQUES**
D. L. MURPHREE, R. L. COOK, W. S. SHEPARD, L. E. BAUMAN, J. D. GASSAWAY, R. E. STICKEL, R. O. DAUBACH, J. C. LUTHE, M. F. ALI, and D. V. SRIKANTAIAH (Mississippi State University, Mississippi State, MS) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 13 p. refs
(Contract DE-AC02-80ET-15601)
(AIAA PAPER 83-0469)

Advanced optical diagnostic instrumentation systems are being developed at Mississippi State University for the U.S. Department of Energy's magnetohydrodynamic program and other fossil energy technologies for the measurement of combustion temperature, slag wall temperature, gas velocity and turbulence profiles, nitric oxide concentration and particle size distribution. This paper describes development of a differential optical absorption technique for the measurement of nitric oxide concentrations, the laser Doppler velocimeter system and recent test stand measurements, and recent time-resolved gas temperature measurements by the sodium line reversal technique A hybrid particle size distribution system applicable to the harsh environment of an MHD flow in the MSU combustion test stand will also be discussed. (Author)

A83-17849
**ESTIMATION OF WAVE POWER POTENTIAL ALONG THE INDIAN COASTLINE**
T. V S. N. RAO and V. SUNDAR (Indian Institute of Technology, Madras, India) Energy (UK), vol. 7, Oct. 1982, p. 839-845.

An assessment of the wave power potential along the Indian coastline has been made for different seasons. The locations off Bombay on the west coast and off Visakhapatnam on the east coast have the greatest wave power potentials. The occurrence of wave heights and periods are presented graphically. Monthly wave power variations for locations along the Indian coastline are also reported. (Author)

A83-18456
**AN ASSESSMENT OF WIND ENERGY RESOURCE FOR NORTHWESTERN CALIFORNIA**
R. E. RUFF and R. M. ENDLICH (SRI International, Menlo Park, CA) In: Heat Transfer and Fluid Mechanics Institute, Meeting, 28th, Sacramento, CA, June 28, 29, 1982, Proceedings. Sacramento, CA, CSUS University Publications, 1982, p. 149-164. Research supported by the California Energy Commission refs

The methodology employed to choose prospective wind farm sites, develop a mesoscale numerical model of the wind regime, and select sites for anemometer emplacement in northwestern California is described. The study began with elimination of prospects governed by legal, aesthetic, and accessibility impediments. Twenty candidate sites, each with 300-1000 acres of land, were found and five were eliminated for environmental reasons. NWS data and other short-term wind data were used, together with topographic maps and U-2 aerial photography to develop a list of ranked sites. A computer simulation was employed with a parameter which accounted for large terrain height variations. A 5-10 km mesh was used in the horizontal and 100 m in the vertical, and a boundary layer of thickness of 800 m was assumed. Contact anemometers and wind vanes, microprocessor controlled and battery powered for a month, were chosen for instrumentation. One year monitoring at 10 m at 15 candidate sites was scheduled to begin in Sept. 1981. D.H.K.

**A83-18560**
**BIOMASS ENERGY**
Solar Energy, vol. 30, no. 1, 1983, p. 1-31. refs

The present analysis of the development status of biomass energy systems has been conducted by the Energy Research Advisory Board with a view to the prospects for biomass energy use by the year 2000, taking into account the research funds and scientific manpower that should be allocated to biomass production and use investigations. It is projected that the net energy from biomass use could increase approximately four-fold from the current level of 1.1-1.3 Q net by the year 2000, although existing estimates of biomass availability have not included all possible constraints imposed by agriculture, forestry, technology, economics and the environment. Biomass energy potentials are primarily constrained by limits on agricultural and forest production, and by the need to maintain a productive and high quality environment It is noted that food and other consumer goods also compete for available biomass resources. O.C.

**N83-10131** State Univ. of New York, Buffalo.
**ROLE OF TIN CATALYSTS IN THE HYDROLIQUEFACTION OF COAL Ph.D. Thesis**
M. C. TSAI 1981 192 p refs
Avail. Univ. Microfilms Order No. DA8204129

The role of tin catalysts was studied for the hydroliquefaction of coal in batch autoclave experiments with tetralin and tin catalysts. Two competing reactions were found to play important roles: hydrogen transfer from tetrahin to coal, and dehydrogenation/hydrogenation in the reaction Tetrahin = Naphthalene + 2H2. Experimental results indicate that (1) the addition of either SnC12 or SnS + NH4Cl strongly catalyzes the production of oil during coal hydro faction; (2) the production of tetralin and heptane soluble 'oils' depends mainly on the catalyst type; and (3) the free gas volume in the reactors at reaction conditions is an important parameter, since it influences the autogenous pressure and thus the mode of action of catalysts.
Dissert. Abstr.

**N83-10132** Utah Univ., Salt Lake City.
**CATALYTIC HYDRODEOXYGENATION OF COAL-DERIVED LIQUIDS AND RELATED OXYGEN-CONTAINING COMPOUNDS Ph.D. Thesis**
G. HAIDER 1981 252 p
Avail: Univ. Microfilms Order No. DA8203386

Systematic catalytic hydrodeoxygenation (HDO) studies of coal derived liquids (CDL) and related model oxygen containing compounds are reported. The studies were performed in specially adapted autoclave systems, using sulfided Co-Mo/Al2O3 and Ni-W/Al2O3 as catalysts. Starting feedstocks are described. Changes in product composition as a function of experimental variables (reaction temperature, hydrogen pressure, reaction time, and catalyst type) were investigated and mechanistic aspects of the HDO reactions elucidated. HDO of the SRC-II distillate was studied as a function of reaction temperature and catalyst by means of elemental, infrared and C(3)NMR analyses of hydrotreated products. The data were used for better understanding of the complex HDO reactions involved both in primary liquefaction processes as well as in catalytic CDL upgrading by correlating the molecular level data obtained in the study of model O containing compounds with results of the investigation of the SRC II distillate. Dissert. Abstr.

**N83-10140#** Yale Univ., New Haven, Conn School of Medicine.
**DEVELOPMENT OF NEWER METHODS FOR THE ISOLATION AND IDENTIFICATION OF CERTAIN COMPONENTS FOUND IN COMPLEX MIXTURES DERIVED FROM ENERGY SOURCES AND THE DETERMINATION OF THEIR TOXICITY VIA BIOASSAY SYSTEMS**
S. R. LIPSKY 22 Jun. 1982 63 p refs
(Contract DE-AC02-76EV-02958)
(DE82-019043; DOE/EV-02958/6) Avail: NTIS HC A04/MF A01

By utilizing a multidimensional gas chromatographic-mass spectrometer system, individual chemical components from complex mixtures of organic compounds derived from certain energy sources were isolated and trapped out into segments of blank fused silica glass capillary tubing. These substances were then introduced into a very sensitive bioassay flow system. Here, the toxicity of these materials present in the 1 to 50 nanogram range was assessed Thus far, from the analysis of over 70 different chemicals determined in this manner and compared with the results obtained with the conventional assay system, an excellent correlation was noted. DOE

**N83-10142#** Technische Univ., Berlin (West Germany).
**INVESTIGATION OF EXTRACTS BY FLUIDIZED BED EXTRACTION Final Report, Aug. 1981**
H. MEIERZUKOECKER and U. HELLWIG Bonn Bundesministerium fuer Forschung und Technologie May 1982 83 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-068; ISSN-0340-7608) Avail. NTIS HC A05/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 17,50

The indirect hydrogenation of coal extracts process in which in a first step the coal is mixed with a hydrogenating solvent and where in a second step after separation of ashes and coal residues the extract is hydrogenated, was studied. Main drawbacks are the extraction process, the separation between extracts and residues, and the instability of the extracts, leading to a rapid deterioration of the ability to be hydrogenated. The hydrogenation ability of extracts obtained by a fluidized bed process, the use of a cheap solvent derivated if possible from the hydrogenating process itself, the adaptability of the process to the use of low grade coal with, for instance, high ash content or of brown coal, and the possibility to transpose the technique from the discontinuous working laboratory installation to a semi-continuous pilot plant were investigated. Author (ESA)

**N83-10143#** Bergbau-Forschung G m.b H., Essen (West Germany). Abt. Physikalische Chemie.
**COAL GASIFICATION OF STEAM-SOLUTED CATALYST Final Report, Dec. 1980**
A. SULIMMA and K. H. VANHEEK Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 50 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-073; ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10,50

It was proven that alkaline catalysts such as K2C03 and KOH, were the most effective catalysts in the gasification process of coal. The way of introducing the catalyst, e.g., by dry mixing with the coal, by impregnating coal with water solutions of the catalyst, or by bounding the catalyst chemically to the coal, were proven to be of prime importance. A method of charging the catalyst under the form of high pressure steam solutions in a fluidized bed processor was investigated. It is shown that this method is efficient, that the acceleration of the gasification process is dependent on the amount of catalyst present in the reactor, as far as the concentration of catalyst exceeds a lower level due to reactions between the catalyst and the coal minerals, and that the catalyst stays in the fluidized bed up to a high degree of gasification. This finding has significance for the allothermic steam gasification of

the PNP project where the coal loaded with catalyst migrates through the horizontal reactor. The reaction rates are increased by a factor of 10 or more even at low initial catalyst concentrations. Author (ESA)

**N83-10145#** Technische Hochschule, Aachen (West Germany) Inst. fuer Aufbereitung.
**DESULFURIZATION OF COAL BY MEANS OF THE BATAC-JIG Final Report, Mar. 1981**
W. SCHOLLMEIER and C. WALENZIK Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 164 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-100; ISSN-0340-7608) Avail: NTIS HC A08/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM *34,50*

The different separation possibilities were studied and it was shown that the jig process is very favorable. Tests with coal in the grain size range from ten to zero mm which permitted to find the best adjustment of the Batac-jig are described. Further investigations on coal in the grain size from two to zero mm were also carried out. The investigation shows that the Batac-jig is suitable for de-ash and desulfurizing of the examined type of coal containing 50 % by weight of finest grains, with a good sharpness of separation. Author (ESA)

**N83-10146#** Kraftwerk Union A.G. Reaktortechnik, Erlangen (West Germany). Hauptbereich Vertrieb und Kraftwerkstechnik.
**HARD COAL GASIFICATION USING CATALYSTS DISSOLVED IN STEAM Final Report, Jan. 1981**
D. REINHARDT Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 181 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-107; ISSN-0340-7608) Avail: NTIS HC A09/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 34,50

Process energy, resulting from a high temperature reactor, is considered. Use of nuclear energy for gasification of hard coal is not economical A method to overcome this difficulty, is to increase gasification rate by adding a catalyst. The catalyst is introduced by dissolving it in the gasifying medium. Poor solubility of the catalytically active salts in steam at pressures below 100 bars, is overcome by a supersaturating technique For very diluted catalyst concentrations, this process appears to be superior compared to concurrent methods of catalyst addition. Moreover, catalyst feed during the course of the reaction might be an advantage of the process. Author (ESA)

**N83-10151#** McNeese State Univ., Lake Charles, La
**STANDARDIZATION OF SAMPLING AND ANALYSIS OF GEOPRESSURED FLUIDS. PART 2: MONITORING OF GEOPRESSURED WELLS Final Report, 1 May 1980 - 31 Jul. 1981**
B. E. HANKINS and O. C. KARKALITS Aug. 1981 91 p refs (Contract GRI-5080-321-0301)
Avail: NTIS HC A05/MF A01 CSCL 07D

Chemical analyses of geopressured fluids (brine and gas) obtained from seven wells are reported. The analyses were made by the on site chemical subcontractor and collaborating research laboratories McNeese State University served as quality control contractor for GRI. McNeese sent aliquots of the samples (referred to as round robin samples) to the collaborators for quality control check analyses. The data have been collated and subjected to a statistical study Based on these data, recommendations have been made regarding future quality control measures and possible revisions of the Standard Procedures Manual. GRA

**N83-10154#** Department of Agriculture, Washington, D.C Economic Research Service
**ESTIMATED CAPACITY OF US ETHANOL PLANTS**
M. GILL and A. D. DARGAN Feb. 1982 38 p refs
(PB82-203647; AGESS-820210) Avail. NTIS HC A03/MF A01 CSCL 07A

Data on U.S alcohol fuel production capacity for 1980 to 83 is given The major feedstock used is corn because of its availability and the technical ease of conversion to alcohol by means of the well-known fermentation process. The Corn Belt is currently the leading alcohol fuel production region. The estimates of likely, optimistic, and highly optimistic capacity by the end of 1983 are 1.5, 1.7, and 2 billion gallons, respectively. These estimates indicate that the national alcohol fuel production goal of 60,000 barrels per day (920 million gallons per year) by the end of 1982 will not be achieved Author (GRA)

**N83-10156#** Battelle Pacific Northwest Labs , Richland, Wash.
**KINETICS AND CATALYSIS OF PRODUCING SYNTHETIC GASES FROM BIOMASS Annual Report, 7 Dec. 1980 - 6 Dec. 1981**
L. J. SEALOCK, JR., D. C. ELLIOTT, R. T. HALLEN, R. D. BARROWS, and S. L. WEBER Dec. 1981 175 p refs
(Contract GRI-5014-361-0242)
(PB82-214347, GRI-80/0116) Avail: NTIS HC A08/MF A01 CSCL 07D

The kinetics, reaction sequences and pathways involved in pyrolysis and catalytic steam gasification of wood and wood components are investigated. A one liter stirred autoclave was used to study gasification in a low temperature regime (100 C to 450 C). The autoclave was successfully modified to allow remote sampling of the liquid and gaseous phases present in the reaction environment. A two inch diameter batch reactor is being used to study gasification at higher tempatures (550 C to 850 C). Kinetic studies of the gasification reactions relative to cellulose, holocellulose, lignin, and Douglas air gasification were completed. Reaction rate constant and activation energies were determined for catalyzed and uncatalyzed cases. The formation of specific compounds during gasification in the presence and absence of catalysts was investigated in both reactor systems. Results of the low and high temperature experiments demonstrated dramatic differences in the kinetics and gas composition as a function of the various catalyst cases and components tested GRA

**N83-10160#** Colorado School of Mines, Golden.
**LIQUID-VAPOR EQUILIBRIUM FOR TERNARY NATURAL GAS SYSTEM Annual Report, Oct. 1980 - Oct. 1981**
A. J. KIDNAY and E. D. SLOAN Sep. 1981 61 p refs
(Contract GRI-5014-363-0198; NSF ENG-79-04440)
(PB82-227679; GRI-82/0008) Avail: NTIS HC A04/MF A01 CSCL 07D

Vapor liquid equilibrium (VLE) data were measured for the nitrogen + carbon dioxide binary system at 220 and 240 K and for the methane + carbon dioxide system at 219.26, 240 and 270 K. Ternary VLE measurements were made for the system N + CH4 + CO2 at 220 K and 6.080, 9.119 and 12.159 MPa, 233.15 K at 8.106 MPa, and 240 K at 7 093, 9.119 and 12.159 MPa The multifluid reference corresponding states method proposed by Teja and Rice was applied to VLE calculations and the results of this method for the binary and ternary systems were compared with the results of the Lee-Kesler.corresponding states correlation and the Peng-Robinson equation of state The multifluid and Lee-Kesler methods give comparable results for the constituent binaries of the N2 + CH4 + CO2 system. However, the multifluid model predictions for the ternary system were superior to the predictions of the Lee-Kesler method. The Peng-Robinson equation of state was found to be better than both corresponding states methods for both binary and ternary system VLE predictions. None of the methods produced good representation near the critical points of the binary and ternary systems Author

**N83-10206** City Univ. of New York, N. Y.
**THE HEAT CAPACITY OF COAL CHARS Ph.D. Thesis**
W Y. WANG 1982 168 p
Avail: Univ. Microfilms Order No. DA820333

During pyrolysis, the solid phase of coal is transformed into a microcrystalline structure with some extent of graphite-like orderliness. It is of interest to determine the thermodynamics of this structure which is believed to be process and coal origin dependent. This study was undertaken to elucidate the effect of the various factors on the heat capacity of coal chars. In order to assess the effect of coal rank and impurity content, several coals were obtained from the Pennsylvania State University Coal Bank. These selected starting materials were , a North Dakota lignite, an Illinois No.6 bituminous and a Virginia coking coal. The carbon content of these coals ranged from 59 to 75 wt% (mineral matter included). Half of each of the received coal sample was demineralized using a tandard procedure. Chars were prepared from the received and demineralized coals by pyrolysis. The heat capacity of these samples increases, in general, with increasing temperature and moisture content, and its behavior and order of magnitude are very similar to pure carbons when compared on a moisture free basis The mineral matter content also affects the measured heat capacity. The thermally transformed mineral matter (ash) contriutes differently to the total heat capacity than the mineral matter in its original form. The moisture-containing coal seems to have higher heat capacity than expected by simple additive principle and shows a broad phase transition around ice point.
Dissert. Abstr.

**N83-10207*#** Midwest Research Inst., Kansas City, Mo.
**EVALUATION OF METHODS FOR RAPID DETERMINATION OF FREEZING POINT OF AVIATION FUELS Final Report**
B. MATHIPRAKASAM Sep. 1982 105 p refs
(Contract NAS3-22543)
(NASA-CR-167981; NAS 1.26:167981; MRI-7014-G) Avail: NTIS HC A06/MF A01 CSCL 21D

Methods for identification of the more promising concepts for the development of a portable instrument to rapidly determine the freezing point of aviation fuels are described. The evaluation process consisted of· (1) collection of information on techniques previously used for the determination of the freezing point, (2) screening and selection of these techniques for further evaluation of their suitability in a portable unit for rapid measurement, and (3) an extensive experimental evaluation of the selected techniques and a final selection of the most promising technique Test apparatuses employing differential thermal analysis and the change in optical transparency during phase change were evaluated and tested. A technique similar to differential thermal analysis using no reference fuel was investigated. In this method, the freezing point was obtained by digitizing the data and locating the point of inflection. Results obtained using this technique compare well with those obtained elsewhere using different techniques. A conceptual design of a portable instrument incorporating this technique is presented. J.D.

**N83-10208*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**LITERATURE SURVEY OF PROPERTIES OF SYNFUELS DERIVED FROM COAL Final Report**
F. FLORES Aug. 1982 187 p refs Presented at ASTM Symp. on alternate fuels and future fuels specifications for stationary gas turbine applications, Phoenix, Ariz., 9-10 Dec. 1981
(Contract DE-AI01-77ET-10350)
(NASA-TM-82739, E-1052; DOE/NASA/10350-30; NAS 1.15:82739) Avail: NTIS HC A09/MF A01 CSCL 21D

A literature survey of the properties of synfuels for ground-based turbine applications is presented. The four major concepts for converting coal into liquid fuels (solvent extraction, catalytic liquefaction, pyrolysis, and indirect liquefaction), and the most important concepts for coal gasification (fixed bed, fluidized bed, entrained flow, and underground gasification) are described. Upgrading processes for coal derived liquid fuels are also descnbed. Data presented for liquid fuels derived from various processes, including H-coal, syntholl, solvent refined coal, COED, donor solvent, zinc chloride hydrocracking, co-steam, and flash pyrolysis. Typical composition, and property data is also presented for low and medium-BTU gases derived from the various coal gasification processes. M.G.

**N83-10210#** Ashland Petroleum Co., Ky. Research and Development Dept.
**REFINING OF MILITARY JET FUELS FROM SHALE OIL. PART 1. PRELIMINARY PROCESS DESIGN, ECONOMIC AND YIELD OPTIMIZATION, AND COMPUTER MODELING Interim Technical Report, Feb. - Jun. 1979**
C. JOHNSON, H. F. MOORE, and W. A. SUTTON Wnght-Patterson AFB, Ohio AFWAL Apr. 1982 187 p refs
(Contract F33615-78-C-2080; AF PROJ. 3048)
(AD-A117511, AFWAL-TR-81-2056-PT-1) Avail: NTIS HC A09/MF A01 CSCL 21D

Phase I work performed was directed at the preparation of an overall processing method based on the application of current refining techniques and an extraction process for the removal of nitrogen from shale oil. This preliminary process analysis was aimed at demonstrating technical as well as economic feasibility. This phase explored two overall processing methods, one providing JP-8 type aviation turbine fuel, the other method providing JP-4 type aviation turbine fuel. It was concluded that this process design offers the potential of producing high yields of aviation turbine fuels from shale oil with product costs competitive with or lower than comparable product slates from other shale refineries. Processing steps are provided that will minimize hydrogen consumption, provide a thermal efficiency greater than 70 percent, and produce residual fuel in quantities less than 10 percent of the total product slate. Author (GRA)

**N83-10211#** Suntech, Inc., Marcus Hook, Pa.
**AN EXPLORATORY RESEARCH AND DEVELOPMENT PROGRAM LEADING TO SPECIFICATIONS FOR AVIATION TURBINE FUEL FROM WHOLE CRUDE SHALE OIL. PART 4: PRODUCTION OF SAMPLES OF MILITARY FUELS FROM RAW SHALE OILS Interim Report, 1 Apr. 1980 - 30 Nov. 1981**
H. E. REIF, J. P. SCHWEDOCK, and A. SCHNEIDER Wright-Patterson AFB, Ohio AFWAL Feb. 1982 73 p Presented at the 3rd Jet Fuel From Shale Oil Technol. Rev., Miamisburg, Ohio, 17-18 Nov. 1981
(Contract F33615-78-C-2024; AF PROJ. 2480)
(AD-A117526; AFWAL-TR-81-2087-PT-4) Avail: NTIS HC A04/MF A01 CSCL 21E

A total of 475 gallons of specification aviation turbine fuels (JP-4, JP-5 and JP-8) were prepared from Occidental Shale Oil based on Sun Tech's upgrading concept. Processing consists of six steps: (1) hydrotreating the whole shale oil to partially reduce total nitrogen content to minimize hydrogen consumption; (2) distilling the hydrotreated product into appropriate fractions for additional processing; (3) rehydrotreating the light distillate fraction to meet product specifications; (4) treating the wide boiling gas oil fraction with anhydrous hydrogen chloride (HCl) which yields a low nitrogen content raffinate and a high nitrogen content extract phase; (5) thermally decomposing the extract to recover anhydrous HCl and a nitrogen-rich extract, which is used for generating hydrogen by partial oxidation; and (6) hydrocracking the raffinate phase to maximize aviation turbine fuel yield. Five 5-gallon samples of specification military fuels were produced from Paraho shale oil (JP-4, JP-5, JP-8, DF-2 and DF Marine) using a modified process. Processing consists of severely hydrotreating raw shale oil followed by fractionation and finally hydrocracking the wide boiling gas oil fraction to produce the desired product slate. GRA

**N83-10212#** JAYCOR, San Diego, Calif.
**COMPUTER MODELING OF MIXING AND AGGLOMERATION IN COAL-CONVERSION REACTORS. VOLUME 1: MODEL FORMULATION Final Report, 15 Sep. 1978 - 28 Feb. 1982**
R. K. C. CHAN, M. J. CHIOU, D. E. DIETRICH, D. R. DION, H. H. KLEIN, D. H. LAIRD, H. B. LEVINE, C. A. MEISTER, M. F. SCHARFF, and B. SRINIVAS Feb. 1982 125 p refs 2 Vol.
(Contract DE-AC21-78ET-10329)
(DE82-014836; DOE/ET-10329/1211-VOL-1; J510-82-007A/2112-VOL-1) Avail: NTIS HC A06/MF A01

The FLAG code consists of the following major modules: gas flow (including gas turbulence), gas phase chemistry, particle dynamics and energetics (including particle dispersion), particle chemistry (including devolatilization and heterogeneous reactions), particle collisions, agglomeration, and heat transfer (conduction and radiation). These physical chemical modules are embodied in computer subprograms. The distinction between a module and a subprogram is that the former is a conceptual division of the significant phenomena, whereas the latter is based on the ease of manipulation within the structure of the computer code. The basic solution procedure is a step by step integration of all the governing equations with respect to time, using a semiimplicit, second order accurate, finite difference scheme. In this procedure, the field variables, such as pressure, temperature, gas species concentration, velocity, etc. are evaluated at a finite set of spatial locations inside the reactor, as the time goes through a sequence of small, but finite increments. DOE

**N83-10213#** Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
**STUDIES RELATED TO THE DEEP EARTH GAS Annual Report, Jan. - Dec. 1981**
T. GOLD, E. BILSON, and S. SOTER Mar. 1982 65 p refs
(Contract GRI-5081-360-0453)
(PB82-227653, GRI-81/0050) Avail: NTIS HC A04/MF A01 CSCL 21D

The origin of terrestrial hydrocarbons, principally of methane and petroleum was elucidated. Methane was successfully reacted with petroleum hydrocarbons. This reaction does occur at a measurable rate in the presence of natural clay catalysts at temperatures and pressures existing in the geological setting of petroleum formation. Upward migrating methane participates in petroleum formation. Evidence concerning regional patterns of hydrocarbon deposits, trace element content, the geologic setting of the deposits and the chemical and physical processes in the upper mantle and the crust, shows that methane from deep sources penetrated the crust in large quantities, and that this has contributed to the formation of much of the world's natural fuel supplies. GRA

**N83-10214*#** National Academy of Sciences - National Research Council, Washington, D. C. Committee on Alternative Aviation Turbine Fuels, Aeronautics and Space Engineering Board.
**AVIATION TURBINE FUELS: AN ASSESSMENT OF ALTERNATIVES Final Report**
Apr. 1982 82 p refs
(Contract NASW-3522)
(NASA-CR-169395; NAS 1.26:169395; PB82-213737) Avail: NTIS HC A05/MF A01 CSCL 21D

The general outlook for aviation turbine fuels, the effect that broadening permissible aviation turbine fuel properties could have on the overall availability of such fuels, the fuel properties most likely to be affected by use of lower grade petroleum crudes, and the research and technology required to ensure that aviation turbine fuels and engines can function satisfactorily with fuels having a range of fuel properties differing from those of current specification fuel are assessed. Views of industry representatives on alternative aviation turbine fuels are presented GRA

**N83-10426#** Engineering Development Establishment, Maribyrnong (Australia).
**INVESTIGATION OF THE PERFORMANCE OF A FORD 4.1 L 6 CYLINDER SI ENGINE OPERATING ON METHONOL ISO-BUTANOL GASOLINE FUEL BLENDS**
D. J. AYERS 1982 24 p refs
(AD-A117746; EDE-10/82; AR002777) Avail. NTIS HC A02/MF A01 CSCL 21D

A laboratory investigation into the relative performance of a Ford Falcon 4.1 L 6 cylinder in line engine when operated on both super grade gasoline and blends of non leaded gasoline, methanol and iso butanol showed that the engine operated satisfactorily on fuel blends containing up to 30% total alcohol For the blends thermal efficiency of the engine for most conditions was improved but some torque loss was experienced under full throttle conditions especially at lower engine speeds This loss increased with increasing proportion of alcohols in the fuel. Author (GRA)

**N83-10430#** Wayne State Univ., Detroit, Mich. Center for Automotive Research.
**SENSITIVITIES OF INTERNAL COMBUSTION AUTOMOTIVE ENGINES TO VARIATIONS IN FUEL PROPERTIES Final Report, Apr. - Dec. 1981**
N. A. HENEIN Washington, D.C. DOT Feb. 1982 236 p refs
(Contract DTRS-57-80-P-80733)
(PB82-194961; DOT-TSC-RSPA-81-13) Avail: NTIS HC A11/MF A01 CSCL 21E

The sensitivity of automotive gasoline and diesel engines to variations in fuel properties was assessed. The variables studied include H/C ratio, distillation range, aromatic content, ignition quality as determined by the octane number, and the autoignition quality as determined by the cetane number The sensitivity of the engine is 'measured' against its power output, fuel economy, emissions, and degradation of lubricants. The sensitivity to the use of alternate fuels such as neat fuels or fuel extenders is discussed. The alternate fuels studied include shale oil derivatives, coal liquefaction derivatives, and alcohols. The impact of using emergency fuels in automotive gasoline and diesel engines is discussed GRA

**N83-10479#** Institut fuer Erdoelforschung, Hanover (West Germany).
**CRITICAL RELATIONSHIPS FOR DISPLACEMENT PROCESSES IN OIL FIELDS Final Report, Oct. 1981**
S. TUNC Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 43 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-093, ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9

The correlation of various essentially defined parameters for displacement processes was examined in order to find the critical values describing oil mobility with the aim of optimal oil recovery. The relationships between the permeabilities and the mobility ratios with displacement efficiency were determined. The three most important dimensionsless characteristic values were discussed with the help of experimental results. It is discovered that with suitable co-surfactants stable microemulsions can be formed between the oil and the water phases. The microemulsion contains almost all the surfactants used. Due to the fact that this middle phase emulsion does not have high viscosity and behaves as a Newton fluid, a very low pressure gradient is encountered during the displacement process so that an optimal displacement efficiency for the system an be achieved. Author (ESA)

**N83-10495#** British Library Lending Div., Boston Spa (England)
**EXPERIMENTS ON THE ADAM 1 PLANT FOR THE OPTIMISATION OF METHANIZATION PROCESS IN THE LONG DISTANCE NUCLEAR ENERGY TRANSMISSION SYSTEM TEST RUN PERFORMED IN THE SPRING OF 1980**
B. HOEHLEIN, R. MENZER, M. VORWERK, and A. SKOV 15 Sep. 1982 44 p refs Transl. into ENGLISH of rept. from Kernforschungsanlage, Julich, West Germany, Oct. 1980 38 p
(BLL-T5869/BG/MRS14614/82) Avail: British Library Lending Div., Boston Spa, Engl.

Various problems of the methanation in gs synthesis to improve the long distance nuclear energy system were investigated. Important results were obtained regarding high temperature methanation of up to 700 C, to a closed steam reforming methanation circuit, and to the operation of a recycle ejector in ADAM 1 which limits the outlet temperature of the first reactor.
E.A.K

**N83-10497** Columbia Univ , New York.
**MEMBRANE CONTROLLED ANAEROBIC DIGESTION Ph.D. Thesis**
D. R. OMSTEAD 1981 155 p
Avail: Univ. Microfilms Order No. DA8204530

In response to general shortages of energy, examination of the anaerboic digestion process as a potential source of a combustible, methane-rich fuel has intensified in recent years. It has been suggested that orgaic intermediates (such as fatty acids), produced during digestion, might also be recovered for use as chemical feedstocks. This investigation has been concerned with combining ultrafiltration separation techniques with anaerobic digestion for the development of a process in which the total production of acetic acid (the most valuable intermediate in anaerobic digestion) and methane are optimized. Enrichment cultures, able to utilize glucose as a sole carbon source, were adapted from sewage digesting cultures using conventional techniques. An ultrafiltration system was constructed and coupled to an anaerobic digester culture vessel which contained the glucose enrichment. The membrane controlled anaerobic digester appears to show promise as a means of producing high rates of both methane gas and acetic acid Dissert. Abstr.

**N83-10503*#** Jet Propulsion Lab , California Inst. of Tech , Pasadena.
**RESOURCE TARGETS FOR ADVANCED UNDERGROUND COAL EXTRACTION SYSTEMS**
J. H. HOAG, D. W. WHIPPLE, H. HABIB-AGAHI, and M. L LAVIN 1 Aug. 1982 128 p refs
(Contract NAS7-100; DE-AI01-76ET-12548)
(NASA-CR-169429; JPL-PUB-82-15; NAS 1 26:169429; DOE/ET-12548/14) Avail: NTIS HC A07/MF A01 CSCL 08I

Resource targets appropriate for federal sponsorship of research and development of advanced underground coal mining systems are identified. A comprehensive examination of conventional and unconventional coals with particular attention to exceptionally thin and thick seams, steeply dipping beds, and multiple seam geometry was made. The results indicate that the resource of primary importance is flat lying bituminous coal of moderate thickness, under moderate cover, and located within the lower 48 states. Resources of secondary importance are the flat lying multiple seams and thin seams (especially those in Appalachia). Steeply dipping coals, abandoned pillars, and exceptionally thick western coals may be important in some regions of subregions, but the limited tonnage available places them in a position of tertiary importance. Author

**N83-10556*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**COMBUSTION OF COAL GAS FUELS IN A STAGED COMBUSTOR**
T J. ROSFJORD, J. B. MCVEY, R. A SEDERQUIST, and D. F. SCHULTZ 1982 14 p refs Presented at the Joint Power Conf., Denver, 17-21 Oct. 1982 Prepared in cooperation with United Technologies Research Center, East Hartford, Conn. and United Technologies Corp , South Windsor, Conn.
(Contract DEN3-149; DE-AI01-77ET-13111)
(NASA-TM-82987; DOE/NASA/13111-12; E-1419; NAS 1.15:82987) Avail: NTIS HC A02/MF A01 CSCL 10B

Gaseous fuels produced from coal resources generally have heating values much lower than natural gas; the low heating value could result in unstable or inefficient combustion Coal gas fuels may contain ammonia which if oxidized in an uncontrolled manner could result in unacceptable nitrogen oxide exhaust emission levels. Previous investigations indicate that staged, rich-lean combustion represents a desirable approach to achieve stable, efficient, low nitrogen oxide emission operation for coal-derived liquid fuels containing up to 0.8-wt pct nitrgoen. An experimental program was conducted to determine whether this fuel tolerance can be extended to include coal-derived gaseous fuels The results of tests with three nitrogen-free fuels having heating values of 100, 250, and 350 Btu/scf and a 250 Btu/scf heating value doped to contain 0 7 pct ammonia are presented. Author

**N83-10557*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**EVALUATION OF ADVANCED COMBUSTION CONCEPTS FOR DRY NO SUB X SUPPRESSION WITH COAL-DERIVED, GASEOUS FUELS**
K. W. BEEBE (GE, Schenectady, N Y.), R. A. SYMONDS (GE, Schenectady, N Y.), and J. J. NOTARDONATO 1982 15 p refs Presented at the Joint Power Conf , Denver, 17-21 Oct 1982
(Contract DE-AI01-77ET-13111)
(NASA-TM-82985, DOE/NASA/13111-11; E-1417; NAS 1.15.82985) Avail. NTIS HC A02/MF A01 CSCL 10B

The emissions performance of a rich lean combustor (developed for liquid fuels) was determined for combustion of simulated coal gases ranging in heating value from 167 to 244 Btu/scf (7.0 to 10.3 MJ/NCM). The 244 Btu/scf gas is typical of the product gas from an oxygen blown gasifier, while the 167 Btu/scf gas is similar to that from an air blown gasifier. NOx performance of the rich lean combustor did not meet program goals with the 244 Btu/scf gas because of high thermal NOx, similar to levels expected from conventional lean burning combustors. The NOx emissions are attributed to inadequate fuel air mixing in the rich stage resulting from the design of the large central fuel nozzle delivering 71% of the total gas flow. NOx yield from ammonia injected into the fuel gas decreased rapidly with increasing ammonia level, and is projected to be less than 10% at NH3 levels of 0.5% or higher. NOx generation from NH3 is significant at ammonia concentrations significantly less than 0.5%. These levels may occur depending on fuel gas cleanup system design. CO emissions, combustion efficiency, smoke and other operational performance parameters were satisfactory. A test was completed with a catalytic combustor concept with petroleum distillate fuel. Reactor stage NOx emissions were low (1.4g NOx/kg fuel). CO emissions and combustion efficiency were satisfactory. Airflow split instabilities occurred which eventually led to test termination. S.L.

**N83-10559*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**MULTIFUEL EVALUATION OF RICH/QUENCH/LEAN COMBUSTOR**
J. J. NOTARDONATO, A. S. NOVICK (Detroit Diesel Allison), and D. L. TROTH (Detroit Diesel Allison) 1982 12 p refs Presented at the Joint Power Conf., Denver, 17-21 October 1982
(Contract DE-AI01-77ET-13111)
(NASA-TM-82986; E-1418; DOE/NASA/13111-10; NAS 1.15:82986) Avail: NTIS HC A02/MF A01 CSCL 21B

The fuel flexible combustor technology was developed for application to the Model 570-K industrial gas turbine engine. The technology, to achieve emission goals, emphasizes dry NOx reduction methods. Due to the high levels of fuel-bound nitrogen (FBN), control of NOx can be effected through a staged combustor with a rich initial combustion zone. A rich/quench/lean variable geometry combustor utilizes the technology presented to achieve low NOx from alternate fuels containing FBN. The results focus on emissions and durability for multifuel operation S.L.

**N83-10563#** Institut Royal Meteorologique de Belgique, Brussels.
**WIND POWER POTENTIAL IN BELGIUM**
L. VANDERAUWERA, F. DEMEYER, and L. M. MALET 1982 24 p refs
(PUBL-SER-B-115; ISSN-0770-4615) Avail: NTIS HC A02/MF A01

The Weibull three-parameter model is discussed for estimation of mean wind power densities. This probability density function is a generalization of a number of more conventional density functions. Using wind speed observations, it is shown that this model generally gives a more reliable fit to the empirical wind speed frequency data than the density functions with one or two parameters. Wind power density estimations turn out to be strongly dependent on the hypothesized probability density function. The variation with height of the three parameters of the discussed model is investigated; no simple height dependence can be proposed. The variability of the yearly mean wind power with time is examined for three stations in Belgium and it is found that deviations of + or - 20 percent of the overall mean value may occur. The geographical variation of the mea wind power density and two examples of a contour map for the generator capacity factor are presented. Author

**N83-10570#** Iowa State Univ. of Science and Technology, Ames.
**FOSSIL-ENERGY Annual Report, 1 Oct. 1980 - 30 Sep. 1981**
Mar. 1982 146 p refs Prepared for Pittsburgh Mining Technology Center, Pa.
(Contract W-7405-ENG-82)
(DE82-018269; IS-4794) Avail: NTIS HC A07/MF A01

Methods for analysis, physical properties, microstructure, and methods for preparation and cleaning of coals are discussed.

**N83-10571#** Iowa State Univ. of Science and Technology, Ames.
**RAPID ANALYSIS OF MINERAL CONTENT OF COAL: DEVELOPMENT OF AN ON-LINE MONITORING INSTRUMENT FOR PYRITE AND ASH IN COAL**
J. E. RENSON and R. A. JACOBSON *In its* Fossil-Energy p 1-12 Mar. 1982
Avail: NTIS HC A07/MF A01

The feasibility of developing a computer-controlled monitor to measure the quantitative and qualitative pyrite and mineral content in coal using X-ray powder diffraction techniques was investigated. The 15 deg pyrite peak is used to measure the pyrite content, since there are no interfering peaks near it caused by the presence of common minerals. It is practical to measure down to 0.5% pyrite in a coal matrix, although with extreme care and long run times, measurement down to 0.2% is possible. The coal is ground to 60 mesh unless mineral matter is being measured, in which case -200 mesh samples are used. The same diffracted intensity is obtained from a low density sample regardless of whether it is 2.5 mm thick or 'infinitely' thick. The sensitivity of the method is reduced by the presence of highly absorbing material. To overcome this problem, an X-ray souce at molybdenum radiation wavelength is used, decreasing the linear absorption coefficient to 115 cm(-1). Refinements of data analysis techniques are summarized. J.D.

**N83-10572#** Iowa State Univ. of Science and Technology, Ames.
**ASHING PROPERTIES OF COAL BLENDS**
D. L. BIGGS *In its* Fossil-Energy p 13-36 Mar. 1982 refs
Avail: NTIS HC A07/MF A01

The fusion properties of sulfur materials present in coals were investigated. The treatment of the samples of eleven different coals is described Thermal treatment of low temperature ashing (LTA) concentrates of eight of the coals was performed, and raw and wash ashing curves were examined to determine what quantitative correlations, if any, exist between ashing parameters and rank of coal. The actual form of the function which describes the ashing curve is derived. J.D.

**N83-10573#** Iowa State Univ. of Science and Technology, Ames.
**COAL PREPARATION AND TESTING**
D. BIRLINGMAIR and R. FISHER *In its* Fossil-Energy p 37-47 Mar. 1982
Avail: NTIS HC A07/MF A01

Upgrading of the pilot plant large scale test facility for testing and evaluating coal preparation equipment, processes, and instrumentation, and for producing large quantities of coal of required specification prepared under controlled conditions is described. A fact sheet describing the coal preparation plant is presented. J.D

**N83-10574#** Iowa State Univ. of Science and Technology, Ames.
**PERFORMANCE CHARACTERISTICS OF HEAVY MEDIA CYCLONES USING FLY ASH-DERIVED HEAVY MEDIA**
D. BIRLINGMAIR and M. J. MURTHA *In its* Fossil-Energy p 49-62 Mar. 1982
Avail: NTIS HC A07/MF A01

The potential for use of the magnetically separated iron-rich fraction of coal fly ash as heavy medium material for float-sink beneficiation of coal was investigated. Comparative coal beneficiation separations are made using commercial magnetite samples and magnetically separated fly ash samples. Laboratory experimentation is used to characterize the heavy media materials, determine particle durability, measure abrasion and corrosion of construction materials, compare media stabilities and viscosities, and determine flow circuit power requirements. Author

**N83-10575#** Iowa State Univ. of Science and Technology, Ames.
**A SYSTEMATIC INVESTIGATION OF THE ORGANOSULFUR COMPONENTS IN COAL**
T. G. SQUIRES and C. G. VENIER *In its* Fossil-Energy p 71-101 Mar 1982 refs
Avail: NTIS HC A07/MF A01

Progress in the development of a highly efficient, low cost chemical method for removing organic sulfur from large quantities of coal is described. The evaluation of existing oxydesulfurization techniques; the modification of existing oxydesulfurization processes; the application of new and established chemical reactions to organosulfur materials; the development of new desulfurization processes; and the determination of the organosulfur functional group distribution in coal are summarized. J.D.

**N83-10576#** Iowa State Univ. of Science and Technology, Ames.
**MICROSTRUCTURE OF COAL**
W. STRASZHEIM and R. T. GREER *In its* Fossil-Energy p 103-132 Mar. 1982 refs
Avail: NTIS HC A07/MF A01

The use of automatic image analysis in conjunction with a scanning electron microscope in order to rapidly measure trace elements in situ was investigated. The association of trace elements with the various organic and mineral phases and the size distribution of the affected phases are discussed. Direct organic sulfur determinations with application to both raw and processed coals and to various macerals within those coals are described. In particular, the technique is being applied with a view to establishing limits of confidence on the results produced, including the estimated difference in sulfur levels between determinations on different samples. J.D.

**N83-10577#** Iowa State Univ. of Science and Technology, Ames.
**PHYSICOCHEMICAL CLEANING AND RECOVERY OF COAL**
T. D. WHEELOCK *In its* Fossil-Energy p 133-145 Mar. 1982 refs
Avail: NTIS HC A07/MF A01

The development and demonstration of a method of depressing iron pyrites which is applicable to both the froth flotation and oil agglomeration methods of cleaning and recovering fine-size coal are described. Author

**N83-10578#** Argonne National Lab., Ill. Energy and Environmental Systems Div.
**PROCEEDINGS OF THE US DEPARTMENT OF ENERGY/ARGONNE NATIONAL LABORATORY CONTRACTORS' RESEARCH AND DEVELOPMENT WORKSHOP: CONVERTING WASTE TO ENERGY**
Feb. 1982 373 p refs Workshop held in Savannah, 1-4 Dec. 1981 Sponsored by DOE
(DE82-014337; ANL/CNSV/TM-96; CONF-811245) Avail: NTIS HC A16/MF A01

Waste energy utilization research is reported.

**N83-10579#** National Bureau of Standards, Washington, D.C. Thermal Processes Div.
**A LABORATORY APPROACH TO OBTAIN SUSPENSION COMBUSTION DATA FOR REUSE DERIVED FUELS**
A. MACEK and S. R. CHARAGUNDLA *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne National Lab. Contractors' Res. and Develop. Workshop p 1-15 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

Laboratory scale measurement of burning rates of entrained RDF samples is discussed. The resulting data are expected to be relevant for estimating the characteristics of (1) pulverized fuel combustion and (2) the suspension fraction of spreader stoker combustion. A furnace is described allowing direct measurement of fuel particle burning times as functions of the parameters of the entraining gas flow. Preliminary results on combustion of a pulverized coal sample in that furnace are presented. An ancillary study of entrainment characteristics of these samples was made in a cold flow elutriation apparatus. Settling velocity data are presented (1) for particles of controlled sizes, shapes and densities representative of RDF and (2) for two screened fractions of an RDF sample. These results will be used in subsequent RDF combustion studies. Author

**N83-10580#** National Bureau of Standards, Washington, D.C. Chemical Thermodynamics Div.
**AN OXYGEN FLOW CALORIMETER FOR DETERMINING THE HEATING VALUE OF KILOGRAM SIZE SAMPLES OF MUNICIPAL SOLID WASTE**
E. S. DOMALSKI, K. L. CHURNEY, A. E. LEDFORD, R. V. RYAN, and M. L. REILLY *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 16-32 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

A calorimeter to determine the enthalpies of combustion of kilogram size samples of minimally processed municipal solid municipal waste (MSW) in flowing oxygen near atmospheric pressure is discussed. The organic fraction of 25 gram pellets of highly processed MSW was burned in pure oxygen to CO2 and H2O in a small prototype calorimeter. The carbon content of the ash and the uncertainty in the amount of CO in the combustion products contribute calorimetric errors of 0.1 percent or less to the enthalpy of combustion. Large pellets of relatively unprocessed MSW have been successfully burned in a prototype kilogram size combustor at a rate of 15 minutes per kilogram with CO/CO2 ratios not greater than 0.1 percent. The design of the kilogram size calorimeter was completed and construction was begun. Author

**N83-10581#** Midwest Research Inst., Kansas City, Mo
**AN ECONOMIC AND ENGINEERING ANALYSIS OF THE FULL-SCALE TROMMEL SCREEN OPERATIONS AT BALTIMORE COUNTY, MARYLAND**
*G. J. HENNON In Argonne National Lab. Proc. of the US Dept.* of Energy/Argonne Natl. Lab. Contractors' Res. and Develop Workshop p 33-47 Feb. 1982 refs
(Contract DE-AC03-80CS-24330)
Avail: NTIS HC A16/MF A01

A trommel screen installed at the Baltimore County municipal solid waste processing facility operated by Teledyne National is evaluated. The objectives of the program are to ascertain the physical performance of the trommel and the economics of operation. The purpose of the trommel and the economics of operation. The purpose of the trommel is to improve air classified refuse derived fuel by removing fine material that is primarily composed of noncombustible small pieces of glass, metal, stones, dirt, and sand. A series of tests have been performed as a function of trommel feed rate and rotational speed in each of the four seasons to determine screening efficiency, energy requirements, costs, cost benefit ratio, and comparison to theory and models. *Recommendations will be made for design and operational* parameters. Author

**N83-10582#** National Bureau of Standards, Washington, D.C Chemical Kinetics Div.
**CHARACTERIZATION OF RDF PROPERTIES THROUGH HIGH PRESSURE DIFFERENTIAL SCANNING CALORIMETRY**
W. TSANG and J. A. WALKER *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 48-64 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

High Pressure Differential Scanning Calorimetry was employed to study the thermal analytical properties of refuse derived fuels (RDF). By comparison with studies on newsprint and polyethylene, four characteristic thermogram peaks are identified with the smoldering combustion of plastics, cellulosic materials and two types of char respectively. Similarities and differences between thermograms of refuse derived fuels and coal samples are noted. The variability of thermal analytical properties as a function of process parameters, sampling, and source was determined. Finally, data from pyrolytic studies using thermogravimetry as well as scanning calorimetry are presented. Author

**N83-10584#** Waste Management, Inc , Pompano Beach, Fla.
**SOLID WASTE TO METHANE GAS (REFCOM)**
H. P MOOIJ *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 72-91 Feb. 1982
Avail: NTIS HC A16/MF A01

RefCOM (refuse conversion to methane), a plant designed to test the commercial feasibility of producing methane gas from organic solid wastes is discussed. Author

**N83-10586#** WED Enterprises, Glendale, Calif.
**WATER HYACINTH WASTEWATER TREATMENT SYSTEM**
B. R. SCHWEGLER, JR. and C. A. LEE *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl Lab. Contractors' Res. and Develop. Workshop p 110-125 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

A prototype water hyacinth wastewater treatment system which is in operation is discussed. The water hyacinth system requires less than 50% of the energy needed to run a comparably sized conventional secondary treatment system When coupled with primary treatment, the water hyacinth system demonstrates removal of 80-90% total suspended solids and B.O.D., meeting secondary treatment standards In the first year of operation, water hyacinth production yielded 47.8 dry metric tons/hectare year. The effects of varying harvest routines and detention times are investigated to optimize wastewater treatment and biomass production. Nutrient removal and biomass conversion to methane gas are investigated E A K.

**N83-10587#** PIDC-Energy Development Corp., Philadelphia, Pa.
**THE FEASIBILITY OF REFUSE-FIRED ENERGY GENERATION IN PHILADELPHIA, PENNSYLVANIA**
W. M. CHRISTMAN, III *In* Argonne National Lab. Proc. of the US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop. Workshop p 131-139 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

The City of Philadelphia presently disposes of 816, 480 megagrams per year (MGY) of residential refuse, with 1 megagram = 10 to the 3rd power hilograms. Alternatives to a base case of continued incineration and landfilling are evaluated. It is assured that the feasibility studies will yield compatible products and will run a uniform economic analysis against the base case, using as inputs the outputs of the feasibility analyses E.A.K.

**N83-10590#** PSE and G Research Corp., Newark, N.J.
**SEWAGE SLUDGE AS A SUPPLEMENTARY UTILITY BOILER FUEL**
M. L. ZWILLENBERG, C. R GUERRA, and J. H SINGLETARY *In* Argonne National Lab. Proc. of US Dept. of Energy/Argonne Natl. Lab. Contractors' Res. and Develop Workshop p 181-195 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

The feasibility of utilizing sewage sludge as a supplementary boiler fuel was studied Samples of sludge from sewage are gathered for chemicals analysis to determine the range of variation of composition and to select typical sludge compositions. Combustion tests are performed, and the effects of sludge combustion on utility boiler performance, corrosion, emission and economics is estimated Design critena for boilers convertible to sludge burning will be developed and a survey of the U.S. utility boiler population enables the estimation of the potential market for sludge as a fuel E.A.K.

**N83-10591#** North Texas State Univ., Denton Dept of Chemistry
**URBAN WASTE AS A POTENTIAL SOURCE FOR BRICK PLANTS**
K. E. DAUGHERTY, A. EBERENDU, J. GRIFFIN, H. GEGBE, C. IKE, and A. ABOO *In* Argonne National Lab. Proc. of US Dept. of Energy/Argonne Natl Lab. Contractors' Res. and Develop. Workshop p 196-210 Feb. 1982 refs
Avail. NTIS HC A16/MF A01

A joint government/industry/university project was formulated to address the technical feasibility of utilizing municipal solid waste (MSW) as a commercial fuel for the brick industry. Specifically, refuse derived fuel (RDF) from MSW was investigated for three potential applications in the brick industry: (1) rotary brick kilns; (2) tunnel brick kilns; and (3) moisture dryers. The successful development of such a procedure would be a dramatic achievement with widespread applicability, transferability, and commercial merit for energy displacement. The sampling, collection, and analysis of MSW, the analysis of RDF, and the potential utilization of RDF as an alternate source of fuel for the brick industry are described. M.G

**N83-10592#** Combustion Power Co., Inc., Menlo Park, Calif
**DEVELOPMENT OF A SOLID WASTE FIRED FLUIDIZED BOILER, PHASE 1**
L. C PREUIT *In* Argonne National Lab. Proc. of US Dept. of Energy/Argonne Natl. Lab Contractors' Res. and Develop Workshop p 211-225 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

Tests were conducted to develop solid waste fired fluid bed boiler (FBB) technology. The fluid bed facility incorporates water tubes for heat extraction and can burn over seven tons of refuse derived fuel per day Municipal solid waste from surrounding communities is shredded and air classified to remove inerts and recoverable materials. Current and past work shows that a fluid bed boiler will be able to operate at excess air levels well below those presently required by conventional grate-type waste fired boilers, and with comparable or superior combustion efficiencies. Tests were conducted to investigate· the range of process conditions over which satisfactory operation can be maintained; suppression of acid gas emissions; recycle of elutriated fines back to the fluid bed, and fuel technology. In previous testing, operation was stable while firing refuse derived fuel for the duration of a 300-hour test No agglomeration of bed material or slag formation was experienced. Low excess air, low exhaust gas emissions, and constant bed temperature demonstrated feasibility of steam generation from fluid bed combustion. M.G.

**N83-10594#** SCS Engineers, Covington, Ky.
**DEMONSTRATION OF LANDFILL GAS ENHANCEMENT TECHNIQUES IN LANDFILL SIMULATORS**
J J. WALSH and W. G. VOGT *In* Argonne National Lab. Proc. Of US Dept. of Energy/Argonne Natl Lab. Workshop p 266-284 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

Various techniques to enhance gas production in sanitary landfills were applied to landfill simulators These techniques include (1) accelerated moisture addition, (2) leachate recycling, (3) buffer addition, (4) nutrient addition, and (5) combinations of the above. Results are compiled through on-going operation and monitoring of sixteen landfill simulators These test cells contain about 380 kg of municipal solid waste. Quantities of buffer and nutrient materials were placed in selected cells at the time of loading. Water is added to all test cells on a monthly basis; leachate is withdrawn from all cells (and recycled on selected cells) also on a monthly basis Daily monitoring of gas volumes and refuse temperatures is performed Gas and leachate samples are collected and analyzed on a monthly basis. Leachate and gas quality and quantity resits are presented for the first 18 months of operation. M.G

**N83-10595#** Engineering-Science, Inc., Arcadia, Calif.
**RESEARCH, DEVELOPMENT AND DEMONSTRATION IN THE DESIGN OF SANITARY LANDFILL TO OPTIMIZE THE GENERATION AND CAPTURE OF COMPRESSIBLE GAS**
M. E. NOSANOV, F. E. TEEPLE, and S. C. BUESCH (City of Los Angeles Dept. of Public Works) *In* Argonne National Lab. Proc. of US Dept. of Energy/Argonne Natl. Lab Contractors' Res. and Develop. Workshop p 336-354 Feb. 1982 refs
Avail: NTIS HC A16/MF A01

The influences of selected factors on the generation and recovery of methane gas from sanitary landfills were investigated. The factors included encapsulation, shredding, air classifying, moisture, and pH Facilities consisting of six model sanitary landfill cells, each with a capacity of approximately 450 cubic yards of municipal waste, and auxiliary subsystems were constructed. Municipal waste in each cell is contained in a 30-mil thick polyvinly chloride plastic sheeting forming a virtually gas-tight envelope. Two cells were filled with as-collected urban waste, two with shredded waste, and two with shredded and air classified waste, constituting three pairs of cells. One of each pair is a control cell with the other used as an experimental variable. Systems were provided for adding measured amounts of water, removing and recirculating leachate, and for extracting gas and measuring gas flow. During testing, gas production and internal cell characteristics were measured to determine the effects of mechanical processing, moisture content, and leachate pH. M.G.

**N83-10596#** New York State Energy Research and Development Authority, Albany.
**LANDFILL GAS RECOVERY: AN ANALYSIS OF RESULTS**
J. M. PETERSON *In* Argonne National Lab. Proc of US Dept. of Energy/Argonne Natl. Lab Contractors' Res and Develop. Workshop P 355-364 Feb 1982 refs
Avail. NTIS HC A16/MF A01

Aspects of landfill gas recovery including the range of gas recovery, production rates, corrosion, medium-Btu industrial applications, and conversion to electricity via an internal combustion engine were investigated. It is estimated that the landfill site studied is capable of producing more than 2.17 x 10 to the 13th power Btu's of gas per year for a period of over eight years. M G.

**N83-10606#** Foster-Miller Associates, Inc., Waltham, Mass.
**EVALUATION OF THE KLOSWALL LONGWALL MINING SYSTEM Final Report**
P J. GUAY Apr. 1982 131 p refs
(Contract DE-AC01-76ET-12489)
(DE82-015881; DOE/ET-12489/T1) Avail: NTIS HC A07/MF A01

A new longwal mining system specifically designed to extract a very deep web (48 inches or deeper) from a longwall panel was studied. Productivity and cost analysis comparing the new mining system with a conventional longwall operation taking a 30 inch wide web is presented. It is shown that the new system will increase annual production and return on investment in most cases. Conceptual drawings and specifications for a high capacity three drum shearer and a unique shield type of roof support specifically designed for very wide web operation are reported. The advantages and problems associated with wide web mining in general and as they relate specifically to the equipment selected for the new mining system are discussed. DOE

**N83-10611#** Davis Energy Group, Calif.
**FEASIBILITY STUDY OF GEOTHERMAL HEATING, MODOC LASSEN HOUSING PROJECT**
Nov. 1981 26 p
(Contract DE-FG06-79ET-27256)
(DE82-015099; DOE/ET-27256/T10) Avail: NTIS HC A03/MF A01

The feasibility of using geothermal water for space and domestic water heating systems is evaluated. For the six units considered, the space heating load is four times the domestic water heating load. Since the geothermal water temperature is uncertain, two scenarios were evaluated. In the first, which assumes 1600F supply temperature, the geothermal system is assumed to satisfy the entire space and domestic water heating loads. In the second, which assumes the supply temperature to be less than 1200F at the wellhead only space heating is provided The economics of the first scenario are quite favorable The investment is even more favorable for the second scenario, due to the higher cost and lower resultant savings for the domestic water components. Forced air space heating from geothermal is recommended. Domestic water heating is recommended pending additional information on supply water temperature. DOE

**N83-10613#** Tennessee Valley Authority, Muscle Shoals, Ala. Office of Agricultural and Chemical Development.
**BIOMASS FUELS UPDATE. TVAS BIOMASS FUELS PROGRAM**
Feb. 1982 28 p
(DE82-904990; TVA/OACD-82/9) Avail: NTIS HC A03/MF A01

Equipment was installed and tests were conducted on the ethanol from hardwood project. Location of hardwoods, to improve forest management, and to reduce the cost of harvesting woody biomass was assessed Substantial underutilized cropland exists in the Valley, and a questionnaire survey was administered to supplement available cropland data. The potential liquid fuel yields and production management practices for alternative starch, sugar, and vegetable oil crops were determined to obtain benchmark data and to evaluate alcohol production from alternative agricultural feedstocks. Workshops were conducted to provide information on production of alcohol DOE

**N83-10615#** Technische Hochschule, Aachen (West Germany). Inst. fuer Eisenhuettenkunde.
**PRESSURE-SWINGING UNDERGROUND GASIFICATION. THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF GASIFICATION, PHASE 2 Final Report, Oct. 1981**
M. MOHTADI, P. BREIDUNG, F. FUHRMANN, K. GUNTERMANN, M. KURTH, M. PAERSCH, G. ROPERTZ, and G. SUBKLEW Bonn Bundesministerium fuer Forschung und Technologie May 1982 114 p refs Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-066; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 24

Simulation experiments were run in order to determine the form of the combustion front, the combustion front velocity, the different type of gases liberated, the effect on quality of steam/oxygen ratio, the efficiency of gasification process, and data for regulating and conducting from the surface the channel gasification process. The simulation of the channel gasification process was performed in coal samples 0.32 m in diameter, 4 m long with an axial channel of 3 cm in diameter. Samples were put in an autoclave working at 1 bar or 10 bar pressure. The simulation of the penetration process was performed with coal samples 1 m long and 170 mm in diameter put in an autoclave able to work at 100 bar pressure. It is stated that the penetration process not usable is without a preliminary increase of coal permeability. Reverse combustion was also tested at pressures of 1 and 10 bar. Theoretical investigations simulated a nonstationary gasification. It is shown that this method is usable in case of oxidizing gasification. Practical confirmation of the computation has to be carried out. The reaction constants by air/steam gasification are calculated. A stationary model studied the effect of gas temperature, of steam/coal ratio, and pressure.
Author (ESA)

**N83-10616#** Bergbau-Forschung G.m.b.H, Essen (West Germany) Abteilung Physikalische Chemie.
**STEAM GASIFICATION OF COAL, PROJECT PROTOTYPE PLANT NUCLEAR PROCESS HEAT: REPORT AT THE END OF THE REFERENCE PHASE Final Report, Dec. 1980**
K. H. VANHEEK Bonn Bundesministerium fuer Forschung und Technologie May 1982 271 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-069; ISSN-0340-7608) Avail: NTIS HC A12/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 43,50

The work carried out in the field of steam gasification of coal is described. On the basis of the status achieved to date, it can be stated that the mode of operation of the gas generator developed, including the direct feeding of caking high volatile coal, is technically feasible. Moreover, throughput can be improved by 65% at minimum by using catalysts. On the whole, industrial application of steam gasification, using nuclear process heat, stays attractive compared with other gasification processes. Not only coal is conserved, but also the costs of the gas manufactured are favorable. As confirmed by recent economic calculations, these are 20 to 25% lower. Author (ESA)

**N83-10617#** Ruhrkohle A.G., Essen (West Germany).
**PNEUMATIC STOWING WITH LATERAL DISCHARGE IN COAL FACES WITH THICK SEAMS Final Report, July 1981**
H. D. SIELAFF Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 46 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie Prepared in cooperation with Bergbau A.G. Lippe and Bergwerk Nordstern
(BMFT-FB-T-82-074; ISSN-0340-7608; RAG-K-330) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9

A method of introducing early bearing and compact pneumatic stowing in thick coal beds was developed. In an early phase, the pneumatic stowing method with lateral discharge was tested in conjunction with special chock supports. Due to difficult geological conditions in the coal bed and to insufficient stability of the special chock support the trial failed after 7 months. The whole system was modified for pneumatic stowing with front discharge and shuttering. This method turned out to be unsuccessful as well. A shield support designed for pneumatic stowing with front discharge was used in another panel of the same coal bed. This method proved successful. Author (ESA)

**N83-10623#** Vereinigte Kesselwerke Duesseldorf (West Germany).
**TECHNICAL STUDY ON THE POSSIBILITIES OF OIL SHALE COMBUSTION IN A FLUIDIZED BED FURNACE INCLUDING COST ESTIMATES FOR A PLANT TO BE BUILT Final Report, Jun. 1981**
M. KUEHL and P. STELLER Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 70 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-085; ISSN-0340-7608; REPT-41.0801.43.11)
Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 13

The possibilities of oil shale combustion in a fluidized bed furnace were studied and the costs for a power plant were estimated An overall concept of oil shale combustion in a fluidized bed furnace is drafted and the final plant size is established, allowing a scaling up of 200 t/hr steam. The concept was technically revised, resulting in a cost estimate of about 15% accuracy. Author (ESA)

**N83-10625#** Rheinische Braunkohlenwerke A.G., Cologne (West Germany). Abt. Forschung und Entwicklung.
**PHOTOTYPE PLANT FOR NUCLEAR PROCESS HEAT (NPH), REFERENCE PHASE. R AND D WORK ON HYDROGENATED COAL GASIFICATION (HCG). FURTHER OPERATION OF SEMI-INDUSTRIAL PLANT FOR HYDROGENATED COAL GASIFICATION Final Report, Dec. 1980**
R FLADERER and L SCHRADER Bonn Bundesministerium fuer Forschung und Technologie Jul 1982 103 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-098; ISSN-0340-7608) Avail: NTIS HC A06/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 21,50

In view of a scale up, leading to a commercial HCG, futher R and D work was performed on the 100 kg C/hr prototype plant The inclined tube for feeding coal into the fluidized bed, the raw gas/hydrogenation gas heat exchanger, and the modified hydrogen source were tested. Influence on carbon gasification efficiency of dimension of coal particles, humidity of coal, hydrogen content of gasification gas, introduction place of coal in gasifier, height of fluidized bed, and ash content of coal were studied. The plant was operated for 19,400 hr, of which more than 7400 hr under gasification conditions. Carbon gasification rates up to 82% with methane content up to 48% were obtained. Author (ESA)

**N83-10629#** Technische Universitaet, Brunswick (West Germany) Inst. fuer Waerme- und Brennstofftechnik
**COMPUTERIZED SIMULATION OF THE DYNAMIC RESPONSE OF A COAL-FIRED POWER PLANT WITH PRESSURIZED FLUIDIZED BED Final Report, Nov. 1981**
J PLACKMEYER Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 45 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-094, ISSN-0340-7608) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 9,50

The simple way of desulfurizing, the efficient combustion of coal, and low carbon monoxide flue gas content of a fluidized bed combustion installation were studied. The dynamic response of a pressurized fluidized bed should also be studied before any construction is started. The physical-mathematical models of all single components were developed and combined in a total computer program. Starting point was the planned pilot plant with gas turbine engine Various modifications of the purely air cooled plant as well as the extension to a combined cycle with additional steam turbine were considered. Operating cases were simulated: starting up, increasing from partial load to full load and vice versa, shut down and breakdowns. Results show that all operating cases could be brought under control as well as breakdowns. The constructive precautions and correct plant practice are described. Author (ESA)

**N83-10631#** Schaefer (Arnold) G.m.b.H., Saarwellingen (West Germany).
**DRY PROCESSING OF POWER PLANT COAL RICH IN INERTS Final Report, Apr. 1981**
J. GROSS and H. DITZLER Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 71 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-101; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15

A system for pneumatic classifying was constructed in order to examine the effects of quality and composition of coal as well as the machine-related factors, such as the sieve shaking frequency, sieve hole size, air distribution, position of the separating weirs, and arrangement of the charging chute. It was determined that the Berry pneumatic table fulfills the requirements for product purity when the supply of material is held constant and the machine related factors are optimized. For a bituminous coal with a mean ash content between 40% and 50%, the best separation results

were obtained. At a purity rate of inerts of over 97%, it was possible to reduce the ash content of the coal by 20%. Due to its compactness, the system can be put in operation at different sites. It is economic to operate, and can be adapted to any required capacity as a result of its modular design. During the tests a high degree of wear was noted on the fan and fan housing. The fan housing was protected to a great extent by synthetic plates.
Author (ESA)

**N83-10638#** Louisiana State Univ., Baton Rouge. Energy Program Office.
**THE DEVELOPMENT OF A GEOPRESSURED ENERGY MANAGEMENT INFORMATION SYSTEM IN SUPPORT OF RESEARCH PLANNING, PHASE 1 Annual Report, Mar. 1980 - Oct. 1981**
A. L. BACHMAN and F. WRIGHTON Oct. 1981 55 p Sponsored by Gas Research Inst.
(PB82-207366; GRI-81/0005) Avail: NTIS HC A04/MF A01 CSCL 10A

The development of an information system on the problems and potential of geopressured gas containing aquifers as well as what is known about unconventional gas production in the Gulf Coast, and the use of this information to formulate a research program to prove economic and technical feasibility is discussed This work led to the conclusion that of six major conventional gas resource options in the Gulf Coast, the one involving gas recovery from reservoirs watered out due to prior production offers the greatest potential in the short term. In these water drive reservoirs, gas is trapped in the pore space as water invades the reservoir (due to gas production). This gas can be recovered by reducing the pressure in the reservoir and thereby causing the trapped gas to expand and become mobile The reduction in reservoir pressure is achieved by high rate water production. The conclusions drawn from analyses of the potential for gas recovery from unconventional sources in the Gulf Coast as well as research and testing already completed are the basis for the proposed research program. The process by which the research program was formulated, intermediate results and the program itself are summarized.
Author

**N83-10640#** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
**GEOTHERMAL COMMUNITY HEATING FOR CAPE CHARLES, VIRGINIA**
C. S. LEFFEL, JR Oct. 1981 28 p refs
(Contract DE-AI01-79ET-27025)
(PB82-184003; JHU/APL/QM-81-133) Avail. NTIS HC A03/MF A01 CSCL 13A

An economic feasibility study for a geothermal community heating system was made for the residential heat load of Cape Charles, Virginia using a computer program. The effects of inflation, interest rates, wellhead temperatures, and the addition of reinjection wells are investigated It is concluded that the utilization of geothermal energy would be feasible if well flows of 500 gal/minute could be obtained and if reinjection of the geothermal fluids were not required. A comparison of the geothermal assisted community system with a coal fired system shows that the coal fired system may be the most attractive alternative to the heating of homes with individual oil fired furnaces. Author (GRA)

**N83-10641#** Gas Research Inst., Chicago, Ill.
**SYMPOSIA ON PULSE-COMBUSTION APPLICATIONS AND CONDENSING HEAT EXCHANGERS**
4 Mar. 1982 65 p Symp. held in Atlanta, 2-4 Mar. 1982 Sponsored in part by Battelle Columbus Labs., DOE and Brookhaven National Lab.
(PB82-184086; GRI-82/0009.1) Avail: NTIS HC A04/MF A01 CSCL 13A

Fuel-firing equipment designed to take advantage of the phenomena of combustion-driven pulsations is discussed. Heat exchangers that are designed to operate in the condensing mode to recover a portion of the water vapor formed in the combustion process are discussed. Author (GRA)

**N83-10643#** Solar Energetics, Inc., Wilmington, Del.
**GEOTHERMAL ENERGY MARKET STUDY ON THE ATLANTIC COASTAL PLAIN: DOVER AIR FORCE BASE GEOTHERMAL ENERGY EVALUATION**
Dec 1981 40 p refs Prepared for Applied Physics Lab, Johns Hopkins Univ., Laurel, Md.
(Contract N00024-81-C-5301; DE-AI01-79ET-27025)
(PB82-183997; JHU/APL/QM-81-144) Avail: NTIS HC A03/MF A01 CSCL 10A

The technical and economic feasibility of the utilization of geothermal energy was examined. Under the load, resource, and economic conditions, the geothermal evaluation is favorable. There is no prescribed method for evaluating economic feasibility. The results of one computer program was developed for technical assistance and technology transfer are shown Other geothermal feasibility studies for site specific locations are listed. GRA

**N83-10652#** Saarberg-Hoelter-Umwelttechnik G.m b H, Saarbruecken (West Germany).
**RECONSTRUCTION AND TESTING OF THE FLUE GAS DESULFURIZING PLANT: WEIHER 2 Final Report, May 1981**
H. IGELBUESCHER, H. GRESCH, W FISCHER, S MIERSCH, and F HOFMANN Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 133 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-108; ISSN-0340-7608) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 28

Cleaning flue gas produced by the combustion of chloride rich combustibles was studied. A secondary water disposal problem arises due to the chloride content if industrial usable gypsum is produced. If the washing water is recycled, its calcium chloride content concentrates till precipitation occurs. A test program was conducted to control increasing chloride concentration through off-watering small quantities of the washing water, and to produce an optimal gypsum quality The off-water which contained 30% by weight of calcium chloride was centrifuged for the recovery of the gypsum and the calcium chloride was then eliminated by crystallization through steam evaporation. Gypsum with a residual humidity of less than 10% by weight of free water, and calcium chloride 99% pure were obtained in nearly all test runs. Optimal operation of the washing fluid with a calcium chloride content from 10% to maximum 20% by weight of CaCl2 is feasible to obtain the requirements of the gypsum industry, namely less than 10% water and less than 0.01% C1, and at the same time produce usable CaC12. Author (ESA)

**N83-10705#** Technische Universitaet, Clausthal-Zellerfeld (West Germany). Inst. fuer Tiefbohrkunde und Erdoelgewinnund
**DEVELOPMENT OF NEW AND IMPROVEMENT OF EXISTING CORE RECOVERY METHODS Final Report, Mar. 1981**
C. MARX and E. J. KROEMER Bonn Bundesministerium fuer Forschung und Technologie Jun 1982 207 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-091; ISSN-0340-7608) Avail. NTIS HC A10/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 36,50

Prospecting of new oil and gas fields through sampling of soil by core drilling was investigated. Two core recovery methods were designed; corresponding prototypes were built and tested. The drill mandrel, the core barrel closing system, solliciation of the barrel by hydraulic friction, and sollicitation of the driving axe during side drilling were studied. The core barrel system with built in hydrostatic drill motor and diamond bit drill was retained. This combination leads to a core sample recovery rate of over 90% and a drill speed increase of 40% over the rotary core sampling system. The KIBM-1 prototype was tested in five drilling applications in deep wells. The sidewall coring system permits recovery of core material from the bore hole wall for boreholes at least eight and a half inches in diameter. Author (ESA)

**N83-10719#** Friedrichs (Theodor) und Co , Schenefeld (West Germany). Meteorolgische Geraete und Systeme.
**SIMPLE ANEMOMETER FOR WIND CLASSIFICATION Final Report, Feb. 1981**
H. J. FRIEDRICHS, B. LORENZEN, and A. HAUG (Fachhochschule, Aachen) Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 29 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-106; ISSN-0340-7608) Avail: NTIS HC A03/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 6

Development of a simple wind velocity data acquisition system independant of an external power supply and operating for long durations without supervision was considered The data are essential for possible location of windmills Automatic classification of data in wind velocity categories was also considered. Equipment consisted of an anemometer with a Reed contact as impulse emitter, an indicator for 4 or 6 wind velocity categories, and four 1,5 V electric batteries, assuring a four month supply. Wind integration time was 6 or 10 minutes. Tests in laboratory, in environmental test chamber, in wind tunnel, and outdoors gave satisfying results. Outdoor tests lasted three months, with temperatures ranging from minus 14 C to plus 17 C, winds from zero to gale force, relative humidity from 25 to 100%, and precipitations of rain, hailstones, and snow. Author (ESA)

**N83-10756#** Virginia Polytechnic Inst and State Univ , Blacksburg.
**MICROBIOLOGICAL STUDIES TOWARDS OPTIMIZATION OF METHANE FROM MARINE PLANT BIOMASS Annual Report, 1 Jul. 1980 - 30 Jun. 1981**
J. G. FERRY and J. S. CHEN Jul. 1981 15 p
(PB82-214362; GRI-81/0009) Avail: NTIS HC A02/MF A01 CSCL 06M

The microbiological conversion of marine plant biomass was studied with stabilized kelp-degrading methane-producing enrichment cultures. Mannitol and alginate are used concurrently. Ethanol is produced shortly after feeding kelp and subsides rapidly. Dissolved hydrogen ranged from 5 nM to 1.2 uM. The appearance of ethanol correlates with increased hydrogen levels which is expected if interspecies hydrogen transfer functions to maintain low concentrations of the more reduced fermentation products. An improved method was developed for measurement of volatile fatty acids in sea water medium based on gas chromatography of the phenyl ester derivatives. Acetate and propionate were found in the greatest concentrations with formate, butyrate and isobutyrate in lower concentrations. The pool sizes will be used with turnover rate constants to determine total flux of each intermediate. A strain of Methanococcus mazei has been isolated that degrades acetate to methane Also, a highly enriched culture of a previously unreported acetate-degrading methanogen was obtained. New strains of hydrogen and formate-utilizing methanogens were isolated. Mannitol and alginate degrading strains were isolated that resemble Cytophaga sp. Formate dehydrogenase from Methanobacterium formicicum was purified 71-fold and initially characterized. The isolated enzyme contains a cofactor not previously reported in methaogens. Author

**N83-11340*#** National Aeronautics and Space Administration *Lewis Research Center, Cleveland, Ohio.*
**RECENT TRENDS IN AVIATION TURBINE FUEL PROPERTIES**
R. FRIEDMAN Oct. 1982 33 p refs
(NASA-TP-2056; E-1127; NAS 1.60:2056) Avail: NTIS HC A03/MF A01 CSCL 21D

Plots and tables, compiled from Department of Energy (and predecessor agency) inspection reports from 1969 to 1980, present ranges, averages, extremes, and trends for most of the 22 properties of Jet A aviation turbine fuel In recent years, average values of aromatics content, mercaptan sulfur content, distillation temperature of 10 percent recovered, smoke point, and freezing point show small but recognizable trends toward their specification limits. About 80 percent of the fuel samples had at least one property near specification, defined as within a standard band about the specification limit. By far the most common near-specification properties were aromatics content, smoke point, and freezing point. Author

**N83-11349#** Cornell Univ., Ithaca, N. Y. School of Chemical Engineering
**COMPUTER SIMULATION AND MOLECULAR THEORY STUDIES OF NATURAL GAS MIXTURES Annual Report, 1 Jan. 1980 - 31 Dec. 1980**
K. E. GUBBINS 31 Jan. 1982 22 p refs Sponsored by Gas Research Inst.
(PB82-22060; GRI-81/0040) Avail: NTIS HC A02/MF A01 CSCL 21D

A technique was developed which enables the chemical potential to be calculated accurately in liquid mixtures by computer simulation. Calculations produce activity coefficients and Henry constants with an accuracy of 1 to 2%. Results were obtained for highly nonideal mixtures, and were used to test predictive methods for such mixtures. Simulation methods for studying polar liquids were also developed. The perturbation theory equation of state was compared with existing engineering methods, and was found to give much better results for mixtures containing polar fluids, particularly when no mixture data is available. This equation of state was used to study supercritical fluid equilibria Correlations for Henry constants for systems with dissolved gases or solids were developed M G.

**N83-11350#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
**PROPULSION AND ENERGETICS PANEL, WORKING GROUP 13 ON ALTERNATIVE JET ENGINE FUELS. VOLUME 1: EXECUTIVE SUMMARY**
R. B. WHYTE, ed. Jul. 1982 16 p 2 Vol.
(AGARD-AR-181-VOL-1; AD-A119916) Avail: NTIS HC A02/MF A01

*Alternative fuels for gas turbine engines which may entail* considerable changes in fuel properties and relaxation of key items in present specifications to ensure adequate supplies are studied. The physical properties as well as the hydrocarbon composition of the fuels and their effects on handling and storage, aircraft fuel systems and engines are investigated. S.L.

**N83-11351#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
**PROPULSION AND ENERGETICS PANEL, WORKING GROUP 13 ON ALTERNATIVE JET ENGINE FUELS. VOLUME 2: MAIN REPORT**
R. B. WHYTE, ed. Jul. 1982 169 p 2 Vol.
(AGARD-AR-181-VOL-2; AD-A119917) Avail: NTIS HC A08/MF A01

Supply/demand of jet engine fuels for use by the in aeronautical research and development efforts was forecast. The effects of potential variations in hydrocarbon fuel properties on the performance, operating envelope, exhaust emissions, durability, maintainability, reliability and safety of aviation gas turbine aircraft was assessed. S.L.

**N83-11364#** Technische Universitaet, Clausthal-Zellerfeld (West Germany). Inst. fuer Tiefbohrkunde und Erdoegewinnung.
***IMPROVEMENT OF THE CASING CEMENTATION OF DEEP AND ULTRADEEP WELLS. PART 1: DRILLING MUDS AND WASHING FLUIDS Final Report, May 1981***
K. H. ARENS and M. AKSTINAT Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 137 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 2 Vol.
(BMFT-FB-T-82-111-PT-1; ISSN-0340-7608) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 29

Drilling muds, washers, and washing fluids were investigated in order to improve the casing cementation of deep and ultradeep wells. Rheological requirements, the temperature stability of mud systems and the properties of nondamaging drilling muds were

studied. For washing fluids, two test methods were developed and the necessity of filter cake removal was shown. The efficiency of several washing fluids was compared and evaluated for various mud systems (drilling muds with and without clays).

Author (ESA)

**N83-11365#** Technische Universitaet, Clausthal-Zellerfeld (West Germany). Inst. fuer Tiefbohrkunde und Erdoegewinnung.

**IMPROVEMENT OF CASING CEMENTATION OF DEEP AND ULTRADEEP WELLS. PART 2: OILFIELD CEMENTS AND CEMENT ADDITIVES Final Report, May 1981**

K. H. ARENS and M. AKSTINAT Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 115 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie 2 Vol.

(BMFT-FB-T-82-112-PT-2; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 24

Oilfield cements and cement additives were investigated in order to improve the casing cementation of deep and ultradeep wells. Characterization and evaluation of the main oil field cements commercially available were studied. The testing was carried out according to American Petroleum Institute API standards and nonstandardized test methods (dynamic modulus of elasticity, expansion/shrinkage), especially the rheology, thickening time and the influence of pressure, temperature and water-cement ratio, were considered. The main emphasis in the field of cement additives was on the evaluation of cement retarders for high temperatures, accelerators, and additives for cement expansion. Furthermore oil field cements were tested, and their properties are described.

Author (ESA)

**N83-11377#** Energy and Environmental Research Corp., Santa Ana, Calif.

**DEVELOPMENT OF CRITERIA FOR EXTENSION OF APPLICABILITY OF LOW-EMISSION, HIGH-EFFICIENCY COAL BURNERS Annual Report, Oct. 1979 - Oct. 1980**

W. NURICK, R PAYNE, J. LEE, P. CASE, S. CHEN, and D. PERSHING Oct. 1981 202 p

(Contract EPA-68-02-2667)

(PB82-197153; EPA-600/7-81-171C; QR-3) Avail: NTIS HC A10/MF A01 CSCL 13A

A program to develop criteria for extending the applicability of low emission, high efficiency coal burners is described. For the small scale fuel studies, 28 coals covering all ranks were tested under a wide variety of conditions to ascertain the impact of coal properties on the fate of fuel nitrogen (N). Significant accomplishments in this part of the program include: (1) bench scale test results confirm the pilot scale concept that decreasing the initial air/fuel ratio decreases fuel NOx formation; (2) detailed studies on optimizing a staged combustion system suggest that the stoichiometry producing minimum NOx emissions is a function of both fuel composition and primary zone conditions, (3) distribution of the total fixed nitrogen (TFN) species--NO, NH3, and HCN--leaving the first stage strongly dependent on coal composition; (4) distribution of the first stage fuel N emissions has a significant impact on second stage exhaust NO emissions (minimum second stage NO emissions depend on competition between first stage NO and increased gas and solid phase N species); and (5) during staged combustion, increasing the rate of heat extraction from the first stage (fuel rich zone) decreases the decay of TFN species, but dramatically decreases TFN conversion in the second stage (first stage extraction reduces exhaust NO emissions).

GRA

**N83-11500#** Ishikawajima-Harima Heavy Industries Co. Ltd., Yokohama (Japan). Welding Research Inst.

**WELDING OF AL-MG ALLOY 5083-0 FOR THE CONSTRUCTION OF LNG STORAGE TANKS**

Y. KURIYAMA, K. MINODA, T. IRISAWA, and H. NAGAOKA 1981 29 p refs Presented at the HW-JIW Colloq. on Production Technol. and Quality Assurance, Nagoya, Japan, 15 Apr. 1981 Avail. NTIS HC A03/MF A01

Liquefied natural gas (LNG) is receiving increasing attention as the most important source of energy in the interim period before coal and nuclear energy can take their turn in large scale energy production. Among the key elements to constitute an LNG supply system are the LNG tankers to transport the fuel from the gas liquefaction stations overseas and the LNG tanks for storing the imported fuel in reception centers at home. The tankers now planned are mostly of the Moss type carrying spherically shaped aluminum alloy tanks installed independently of the ship's hull. The capacity increase of these tanks as well as their contruction in larger numbers in recent years have largely been made possible by improving the weldability of materials, by the adoption of better designs, by rationalizing construction methods and by automation of welding operations. The total techniques involving the production of Al-Mg alloy 5083-0 thick plate and its welding fabrication are the techniques which have rapidly developed in keeping with the growing demand of LNG and therefore there still remain some subjects on which further study is called for. The subjects that have been studied so far are surveyed concerning welding processes of 5083-0 thick plates, mechanical properties of the welded joints and measures for the prevention of weld defects, intended mainly for LNG tank construction.

Author

**N83-11583#** Rycon, Inc., Cincinnati, Ohio.

**PERFORMANCE ANALYSIS OF COFIRING DENSIFIED REFUSE DERIVED FUEL IN A MILITARY BOILER Final Report, Aug. 1980 - Sep. 1981**

Tyndall AFB, Fla. Air Force Engineering and Services Center Dec 1981 93 p

(Contract MIPR-N-80-50; AF PROJ. 2054)

(AD-A118022; AFESC/ESL-TR-81-59) Avail: NTIS HC A05/MF A01 CSCL 21D

This report provides an overview of existing densified refuse-derived fuel (dRDF) receiving, storage, handling and combustion equipment at Wright-Patterson Air Foce Base. DRDF is being burned as part of a long term alternative fuel evaluation program to develop design and procurement criteria for multiple fuel boilers. Recommendations are offered for specific equipment, procedural changes, and studies to improve the efficacy of the present configurations of dRDF as a fuel. A discussion of the fuel use criteria is presented. The options for continuing the present dRDF supply arrangement vs. the feasibility of local production of dRDF are presented. Research needs are summarized. A preemptive, integrated local synthetic solid fuel production facility and boiler performance test is recommended as a continuation of the program

Author (GRA)

**N83-11587#** Center Four Engineering, Redmond, Oreg.

**BASIN VIEW GEOTHERMAL HEATING DISTRICT, KLAMATH FALLS, OREGON. CONCEPTUAL DESIGN AND ECONOMIC-FEASIBILITY STUDY REPORT**

1 Jul. 1981 63 p Prepared for Oregon Inst. of Tech., Klamath Falls

(Contract DE-FG06-79ET-27256)

(DE82-015108; DOE/ET-27256/T20) Avail: NTIS HC A04/MF A01

The findings of a feasibility study performed for Basin View Heating District in Klamath Falls, Oregon are reported. The physical, economic, and political feasibility of establishing a geothermal heating district to provide space heat to housing units in the Basin View Development of Klamath Falls are determined. Of the several systems considered, all are physically feasible. The project is politically feasible if the owner complies with governmental requirements. Economic feasibility is based on considerations of money value rates, tax rates and expected rates of return, which

are dependent on government and money markets. For analysis a money value rate of 21% and an owner's marginal tax rate of 35% were adopted. DOE

**N83-11595#** Imhausen-Chemie G.m.b.H., Lahr (West Germany).
**THE JOINT AUSTRALIA/FEDERAL REPUBLIC OF GERMANY FEASIBILITY STUDY ON THE CONVERSION OF AUSTRALIAN COALS INTO LIQUID FUELS IN AUSTRALIA Final Report, Aug. 1981**
K. H. IMHAUSEN Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 111 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-133; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 23

The IG hydrogenation process used commercially in Germany up to 1945, was improved. Pilot plants in Germany are presently under construction or in the start-up phase A technical concept for the conversion of Australian bituminous coals and/or Australian brown coals into automotive fuels, using coal hydrogenation, gasification and Fisher-Tropsch synthesis was developed. Development of technology, consumption figures and of expenditure/investment for a complete plant, producing about 3 million tons of automotive fuels per year, was also attempted. The results show that standard automotive fuels are produced from bituminous coal, using a combination of high pressure coal hydrogenation and of Fisher-Tropsch synthesis, and from brown coal, using high pressure coal hydrogenation only. Under the assumption that crude oil prices increase 3% more rapidly than yearly inflation, and the raw material cost are staying at a low level, commercial plants are planned. Author (ESA)

**N83-11596#** Stadtwerke Duisberg A.G. (West Germany).
**STEAM GENERATOR WITH CIRCULATING ATMOSPHERIC FLUIDIZED BED COMBUSTION Final Report, Apr. 1981**
W. WEIN, H. HOEFFGEN, K. H. MAINTOK (Deutsch Babcock Anlagen AG), and G. DARADIMOS (Lurgi Chemie und Huettentechnik GmbH) Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 58 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-134; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 12

The combustion of coal in power plants by conventional combustion techniques is studied with emphasis on combustion in a circulating atmospheric fluidized bed (CFBC). The CFBC method stays half way between the classical fluidized bed with a well defined bed height and the pneumatic transport where particles and fluidizing gas have the same velocity. The main advantages of CFBC are: flexibility with respect to coal types; easy elimination of 80% of sulfur by mixing the coal with calcium carbonate to a molecular ratio Ca/S of about two; reduced nitrogen oxides production due to the low combustion temperature of 900 C; high steam production efficiency with the combustion degree exceeding 99%; high overall efficiency with no further desulfurizing being needed; easy regulation; high heat transmission rates (350 to 400 W/m2K) reducing exchange surfaces; small boiler building; and the possibility to build in one module a 300 MW unit.
Author (ESA)

**N83-11600#** Eschweiler Bergwerks-Verein A.G., Herzogenrath-Kohlscheid (West Germany).
**UTILIZATION OF ANCIT PLANT BY-PRODUCTS Final Report, Feb. 1982**
F. BECKMANN Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 88 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-144; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18,50

In the ANCIT process, briquets are produced composed of 70% low volatile coal, coke, and/or petroleum coke mixed with 30% caking coal as a binder heated at 500 C and hot pressed. A further development was to transform into economically usable products the by-products resulting from this process. The already existing production plant was modified to: collect and transform into usable form the dust and the condensable products contained in the hot gases evolving from the process; use the latent heat of these gases for drying a part of the primary coal used; tend to an autartic process; and reduce pollution from air and water. A plant, to be planned, is able to utilize the ANCIT by-products economically. Author (ESA)

**N83-11638#** Geological Survey, Washington, D. C.
**GEOLOGICAL STUDIES OF THE COST NUMBERS G-1 AND G-2 WELLS, UNITED STATES NORTH ATLANTIC OUTER CONTINENTAL SHELF**
P. A. SCHOLLE, ed. and C R. WENKAM, ed. 1982 200 p refs
(USGS-CIRC-861) Avail: NTIS HC A09/MF A01

Measurements of vitrinite reflectance, color alteration of visible organic matter, and various organic geochemical properties suggest that the tertiary and cretaceous strata of the COST Nos. G-1 and G-2 are not prospective for oil and gas. These sediments were not buried deeply enough for hydrocarbon generation, and the kerogen and extractable organic matter in them are thermally immature. However, the Jurassic rocks at the G-1 site do contain small amounts of thermally mature gas prone kerogens. The Jurassic rocks at COST No. G-2 are also gas prone and are slightly richer in organic carbon and total extractable hydrocarbons than the G-1 rocks, but both sites have only poor to fair oil and gas source rock potential. S.L.

**N83-11653#** Texas Univ., Austin. Bureau of Economic Geology
**GEOLOGIC STUDIES OF GEOPRESSURED AND HYDROPRESSURED ZONES IN TEXAS: TEST WELL SITE SELECTION Final Report, Jan. 1979 - May 1980**
B. R. WEISE, M. B. EDWARDS, A. R. GREGORY, H. S. HAMLIN, L. A. JIRIK, and R. A. MORTON Sep. 1981 334 p refs
(Contract GRI-5011-321-0125)
(PB82-220542; GRI-80/0048) Avail: NTIS HC A15/MF A01 CSCL 08I

Sites for test wells that will be capable of long term production of methane bearing water from the shallow geopressured and deep hydropressured zones were identified. Test well site selection to obtain knowledge of shallow geopressured and deep hydropressured aquifers included: (1) zones within the geopressured and deep hydropressured section of the Texas Gulf Coast Tertiary were defined on the basis of pressure gradients and temperatures, (2) high sandstone corridors were identified for each of these zones; (3) five fairways, or areas of greatest net sandstone thickness, were located within the corridors, areas most prospective for testing entrained methane resources in the shallow geopressured and deep hydropressured zones were identified in each fairway; (4) test sites were selected in four of the prospect areas. Data gained from these geologic studies and testing will be significant in the evaluation of the technical and economic feasibility of producing solution gas from the shallow geopressured and deep hydropressured zones and comparison of these zones with deeper, hotter geopressured zones as sources of entrained methane. GRA

**N83-12199#** AeroChem Research Labs., Inc., Princeton, N. J.
**SOOT FORMATION IN SYNFUELS Quarterly Report, 1 Apr. - 30 Jun. 1981**
D. B. OLSON Nov. 1981 22 p refs
(Contract DE-AC22-80PC-30304)
(DE82-004271; DOE/PC-30304/3; TN-22; QR-3) Avail: NTIS HC A02/MF A01

The effects of fuel molecular structure, flame temperature, and pressure on soot production in laboratory flames of selected synfuel component hydrocarbons are discussed. The threshold sooting index, flame temperature, and soot concentration in premixed and diffusion flames of approximately 50 fuel components were

measured. A fuel vaporizer system was constructed, solving a significant problem in the emission pyrometer. Soot concentration measurements using a near IR light extinction technique were made. Experiments on a C2H2/O2 flame to provide an absolute calibration for flame ion concentration measurements were done and modifications to the mass spectrometer system for sampling from high pressure flames were made. DOE

**N83-12201#** Department of Energy, Grand Forks, N. Dak. Energy Technology Center.
**LIQUEFACTION BEHAVIOR OF AN AUSTRALIAN BROWN COAL IN COMPARISON TO THAT OF TWO US LIGNITES**
G G. BAKER, W. G WILLSON, C. L. KNUDSON, S. A. FARNUM, and B. W. FARNUM Sep. 1982 35 p
(DE82-021977; DOE/GFETC/RI-82/2) Avail: NTIS HC A03/MF A01

Data presented in this report suggest the following major conclusions: (1) The Australian brown coal (predried to 10 pct moisture), at the conditions tested, resulted in lower yields than any of the US lignites or subbituminous coals tested thus far. (2) Distillate yield from the Australian coal was increased by continuous process unit bottoms recycle operation with syngas although not increased to the same level observed for North Dakota or Texas lignites processed at similar conditions, but with hydrogen. (3) The Australian coal responded to changes in operating conditions in a manner similar to North Dakota lignites; however, the total conversion and yields were always less. (4) The Australian coal tested appears to have been deactivated during the drying process, which is known to happen to US lignites dried in the presence of air or inert gas. DOE

**N83-12202#** Department of Energy, Bartlesville, Okla Energy Technology Center.
**AUTOMATED PROBE MICRODISTILLATION/MASS SPECTROMETRY FOR THE ANALYSIS OF HIGH-MOLECULAR WEIGHT COMPOUNDS IN FOSSIL FUELS**
S. E. SCHEPPELE, Q. G GRINDSTAFF, R. D. GRIGSBY, K. C. CHUNG, C. S. HWANG, T. D. MARRIOTT, and L. R. SCHRONK Aug. 1982 24 p refs
(PB82-022039; DOE/BETC/TPR-82/1) Avail: NTIS HC A02/MF A01

Automated probe microdistillation/mass spectroscopy is described. The application of computer hardware and the development of computer software eliminate the dilatory nature of acquiring both the temperature and associated mass spectra and reduces the acquired data for processing. The interaction of various hardware components of the system as well as the associated software is described. DOE

**N83-12204#** National Coal Board, Leatherhead (England). Coal Utilization Research Lab.
**FLUIDISED-BED COMBUSTION: COMBUSTION OF RUN-OF-MINE COAL IN A 12-INCH-DIAMETER PRESSURIZED FLUIDISED-BED COMBUSTOR**
K. K PILLAI, S. N. BARKER, and A. G. ROBERTS 1981 76 p refs
(Contract DE-AC21-80MC-14129)
(DE82-018786; DOE/MC-14129/1208) Avail: NTIS HC A05/MF A01

Direct feeding of run-of-mine coal into a pressurized-fluidized bed combustor was performed at the Coal Utilization Research Laboratory; Leatherhead, United Kingdom (U.K.). A twelve-inch diameter rig was operated at 6 atmosphere pressure and 16500 F for a period of eighteen hours. Two coals were used, i.e., a U.K. washed coal for initial proving tests and a Pittsburgh No. 8 coal, both sized one inch to zero. Results were encouraging and are presented. DOE

**N83-12207#** National Bureau of Standards, Washington, D.C. Chemical Thermodynamics Div.
**THERMODYNAMIC DATA FOR DESULFURIZATION PROCESSES Final Report**
V. B. PARKER, B. R. STAPLES, T. L. JOBE, JR., and D. B. NEUMANN Sep. 1981 92 p refs
(Contract DE-AI21-80-MC14004)
(PB82-184904; NBSIR-81-2345) Avail: NTIS HC A05/MF A01 CSCL 07D

Values of thermochemical properties and processes at 298.15 K for flue gas desulfurization are presented. The substances covered are: (1) the aqueous ions: OH(-), SO3(-2), HSO3(-1) SO4(-4), CO3(-2) HCO3(-), H(+), Mn(+2), Fe(+2), Mg(+2), Ca(+2), Na(+), and K(+), and (2) solid, liquid, aqueous, and gaseous compounds or species formed from these ions. The tables contain the following: the thermochemical property values, enthalpy of formation, delta sub f H deg Gibbs energy of formation, delta sub f G deg, entropy, S deg, and heat capacity, C sub P deg all at 298.15 K, as well as the enthalpy difference between 298.15 K and O K, H deg H sub 0 deg for the basic species are presented. The predicted values for delta H deg, delta G deg, and delta S deg as well as log K (equilibrium constant) for the processes, or reactions, are also presented. The property values, theta sub L, the relative apparent molar enthalpy, gamma(+) from the mean ionic activity coefficient, and theta, the osmotic coefficient, for binary aqueous systems at 298 15 K, all as a function of concentration are included. GRA

**N83-12208#** Rice Univ., Houston, Tex. GA730486
**PHASE EQUILIBRIUM STUDIES FOR METHANE/SYNTHESIS GAS SEPARATION: THE HYDROGEN-CARBON MONOXIDE-METHANE SYSTEM**
J. H. HONG and R. KOBAYASHI Apr. 1982 34 p refs
(PB82-200637; GRI-79/0113; RR-55) Avail: NTIS HC A03/MF A01 CSCL 07D

Vapor liquid equilibria for hydrogen-carbon monoxide-methane ternary system and associated binaries were investigated. The composite data are of particular benefit to the supplemental gas industry, wherein the separation of product methane from recycle gas is of major importance. A reliable data base from which accurate equilibria prediction models may be developed is presented. GRA

**N83-12246*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**ANTIMISTING KEROSENE ATOMIZATION AND FLAMMABILITY**
R. FLEETER, R. A. PETERSEN, R. D. TOAZ, A. JAKUB, and V. SAROHIA Jul. 1982 182 p refs
(Contract FA-03-80-A-00215)
(NASA-CR-169385; NAS 1.26:169385; JPL-PUB-82-40; DOT/FAA-CT-82-19; AD-A120671) Avail: NTIS HC A09/MF A01

Various parameters found to affect the flammability of antimisting kerosene (Jet A + polymer additive) are investigated. Digital image processing was integrated into a technique for measurement of fuel spray charactenstics. This technique was developed to avoid many of the error sources inherent to other spray assessment techniques and was applied to the study of engine fuel nozzle atomization performance with Jet A and antimisting fuel. Aircraft accident fuel spill and ignition dynamics were modeled in a steady state simulator allowing flammability to be measured as a function of airspeed, fuel flow rate, fuel jet Reynolds number and polymer concentration. The digital imaging technique was employed to measure spray characteristics in this simulation and these results were related to flammability test results. Scaling relationships were investigated through correlation of experimental results with characteristic dimensions spanning more than two orders of magnitude. S.L.

**N83-12248*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**FRICTIONAL CHARACTERISTICS AND HEAT TRANSFER OF ANTIMISTING FUELS IN TUBES Final Report, Aug. 1980 - Sep. 1981**
J. WAT and V. SAROHIA Aug. 1982 70 p refs
(Contract NAS7-100; DTFA03-80-A-00215)
(NASA-CR-169388; JPL-PUBL-82-53; NAS 1.26.169388; FAA-CT-82-20) Avail: NTIS HC A04/MF A01

The modification in flow and heat transfer behavior caused by the presence of the antimisting polymer additive FM-9 in jet fuel was determined. The antimisting kerosene (AMK) skin friction versus Reynolds number, or Nusselt number versus Reynolds number behavior, can be divided into three regions: (1) Newtonian laminar region, (2) shear-thickening transition region, and (3) drag reduction turbulent region. At low flow rates, AMK has Newtonian behavior, i.e. constant viscosity. At a certain critical wall shear rate which depends on the fuel temperature and additive concentration, shear thickening occurs and causes a large increase in skin friction and heat transfer rates In the third region, the skin friction and heat transfer rates drop rapidly and fall below the predicted Newtonian flow skin friction and heat transfer values; e.g., for 0.3 percent FM-9 AMK at a temperature of 20 C, these values coincide with Newtonian values at solvent Reynolds number, equal to 2.2 x 10 to the 4th power and 1.0 x to the 4th power Beyond these points, there is a reduction in skin friction and heat transfer rates. Author

**N83-12250*#** Pennsylvania State Univ., University Park. Center for Air Environment Studies.
**PERFORMANCE AND EMISSIONS CHARACTERISTICS OF AQUEOUS ALCOHOL FUMES IN A DI DIESEL ENGINE Final Report**
J. B HEISEY and S. S. LESTZ Aug. 1981 141 p refs
(Contract DE-AI01-81CS-50006; NAG3-91)
(NASA-CR-167917; DOE/NASA/0091-2; NAS 1.26:167917; CAES-590-81) Avail: NTIS HC A07/MF A01 CSCL 21D

A single cylinder DI Diesel engine was fumigated with ethanol and methanol in amounts up to 55% of the total fuel energy. The effects of aqueous alcohol fumigation on engine thermal efficiency, combustion intensity and gaseous exhaust emissions were determined. Assessment of changes in the biological activity of raw particulate and its soluble organic fraction were also made using the Salmonella typhimurium test. Alcohol fumigation improved thermal efficiency slightly at moderate and heavy loads, but increased ignition delay at all operating conditions. Carbon monoxide and unburned hydrocarbon emission generally increased with alcohol fumigation and showed no dependence on alcohol type or quality. Oxide of nitrogen emission showed a strong dependence on alcohol quality; relative emission levels decreased with increasing water content of the fumigant. Particulate mass loading rates were lower for ethanol fueled conditions. However, the biological activity of both the raw particulate and its soluble organic fraction was enhanced by ethanol fumigation at most operating conditions. S.L.

**N83-12252#** Battelle Columbus Labs., Ohio.
**ANALYTICAL TECHNIQUES FOR AROMATIC COMPONENTS IN AIRCRAFT FUELS Final Technical Report, 15 Jun. 1978 - 30 Sep. 1981**
J. S. WARNER, T H. DANISON, and J. S. MCNULTY Wright-Patterson AFB, Ohio AFWAL May 1982 155 p refs
(Contract F33615-78-C-2019; AF PROJ. 3048)
(AD-A118838; AFWAL-TR-82-2015) Avail. NTIS HC A08/MF A01 CSCL 21D

An ultraviolet detector was shown to be highly satisfactory for the selective determination of aromatic components in jet fuels. The detector was operated at 208 nm and used with a fused silica capillary column gas chromatographic system. The detector gave a linear response in the range of interest and could detect individual benzenes and naphthalenes in jet fuels at levels down to 0.01% and 0 002% respectively. Nitrogen-containing compounds were determined by the use of an alkali flame detector, high pressure liquid chromatography, and mass spectrometry Author (GRA)

**N83-12253#** Argonne National Lab., Ill. Materials Science Div.
**MATERIALS TECHNOLOGY FOR COAL-CONVERSION PROCESSES Progress Report, Apr. - Jun. 1981**
W A. ELLINGSON Sep 1981 49 p refs
(Contract W-31-109-ENG-38)
(DE82-004036; ANL/FE-81-53) Avail: NTIS HC A03/MF A01

Coal-slag/refractory interactions, ultrasonic erosion monitoring of metals, fluid acoustics, high temperature gaseous corrosion of metal alloys, and failure analysis were studied. Work on coal-slag/refractory interaction included the design of a gas fired rotating drum dynamic slag corrosion test furnace. Field tests on the high pressure loop (1 1/4 in. 321 SS piping) at the solvent refined coal liquefaction pilot plant were terminated because of excessive erosive wear (1 27 mm lost). Longitudinal and shear wave velocity measurements from room temperature to 5400 C were obtained on Types 304, 304L, 316, 347, and 410 stainless steels, Fe-2 1/4 Cr-1 Mo steel, Stellite 6B, Haynes metal, cold rolled steel, and cast stainless steel. Work on the fluid acoustic test loop included changing all seals at the flange joints and calibrating the volumetric flowmeter by using an ASME orifice plate installed in the test section Agreement within 10% was achieved. The loop was cycled several dozen times over a wide range of flow rates. DOE

**N83-12254#** Argonne National Lab., Ill. Components Technology Div.
**STATE-OF-THE-ART OF ACOUSTIC INSTRUMENTATION FOR COAL-CONVERSION PLANTS**
A. C. RAPTIS and T. K. LAU (DOE) Oct. 1981 129 p refs
(Contract W-31-109-ENG-38)
(DE82-004037; ANL/FE-49628-TM04) Avail: NTIS HC A07/MF A01

The state-of-the-art in development of acoustic instruments for coal conversion plants is presented. The feasibility for flow and temperature measrement parameters of the Sonar Equation and environmental conditions like: (1) attenuation of sound in coal conversion media; (2) the noise background levels in coal conversion plants; and (3) acoustic transducer and other material characteristics need to meet the requirements of the hostile environment. The current state of development of the high temperature acoustic Doppler flowmeter, active acoustic cross correlation flowmeter, and the acoustic flow/noflow indicator is emphasized. DOE

**N83-12255#** Mueller Associates, Inc., Baltimore, Md.
**STATUS OF ALCOHOL-FUELS-UTILIZATION TECHNOLOGY FOR HIGHWAY TRANSPORTATION: A 1981 PERSPECTIVE. VOLUME 1. SPARK-IGNITION ENGINES**
P. W. MCCALLUM and T. J. TIMBARIO May 1982 99 p refs 2 Vol.
(Contract DE-AC05-79CS-56051)
(DE82-020493; DOE/CS-56051/7) Avail: NTIS HC A05/MF A01

The technology(ies) of alcohol utilization in highway transportation is reviewed The use of methanol, ethanol, and certain of their derivatives in vehicles powered by spark ignition engines is treated. The results of engine, vehicle, and fuels testing are summarized. Exhaust emissions, performance and fuel economy, vehicle driveability, fuel systems materials compatibility, engine and vehicle design, fuels characterization, and environmental considerations are discussed. Important properties of selected alcohols and alcohol-derived fuels are described. DOE

**N83-12256#** Idaho Univ., Moscow.
**GASIFICATION KINETICS FOR BIOMASS DECOMPOSITION Annual Report, Jul. 1980 - Jun. 1981**
G. M. SIMMONS, S. RAMACHANDRAN, and W. LEE Jul. 1981 36 p refs
(Contract GRI-5080-363-0306)
(PB82-199043; GRI-81/0026) Avail: NTIS HC A03/MF A01 CSCL 21D

An extensive literature review has been completed on the thermal decomposition of cellulose and wood. A possible reaction path has been proposed. Experimental decomposition experiments which determine the rate of gas formation, as opposed to weight loss, have identified at least two separate rate constants which are consistent with the suggestion of competing reactions. Future work will incorporate detailed modeling of transport processes to ascertain the limits and dependencies of reactor rates on heat and mass transfer. GRA

**N83-12257#** Joyce (T J.) Associates, Fairfax, Va.
**ASSESSMENT OF RESEARCH AND DEVELOPMENT NEEDS FOR METHANE FUELED ENGINE SYSTEMS Final Report, Aug. 1981 - Mar. 1982**
T. J. JOYCE Mar. 1982 187 p refs
(Contract GRI-5081-310-0507)
(PB82-199035) Avail: NTIS HC A09/MF A01 CSCL 21D

The most significant technical, economic and institutional problems which have limited the use of natural gas as a fuel for stationary and mobile engines were identified and a research and development plan which would, if successful, resolve them was prepared. Problem identification was carried out through a mail canvass of equipment suppliers, vehicle operators, gas utilities and government organizations plus personal interviews with a number of the respondents. Research and development programs to develop improved equipment for use of compressed natural gas and liquefied natural gas as a vehicle fuel were reviewed. GRA

**N83-12390#** Wyoming Univ, Laramie. Dept. of Mechanical Engineering.
**DATA COLLECTION AND ANALYSIS FOR GEOTHERMAL RESEARCH Final Report**
J. NYDAHL, K. PELL, D. SENSER, G. TWITCHELL, and S. OWNBEY Aug. 1981 128 p refs Prepared for the Colorado Div. of Highways
(PB82-185430; CDH-UW-R-81-11; FHWA-CO-81-11) Avail: NTIS HC A07/MF A01 CSCL 13B

A prototype bridge deck heating system that utilizes heat pipes to transfer the energy between a warm water source and the deck surface was tested for possible use on some of the I-70 structures through the geothermally active Glenwood Canyon. At water flow rates around 35 GPM and temperatures of 25 C, the snow cover duration on the 59 sq m of heated surface was reduced between 96% and 100% and the deck's frozen time was reduced between 85% and 95% for the five different heat pipe configurations tested; this despite the fact that over a 1 1/4 thick sludge was deposited on all the unprotected metallic surfaces exposed to the geothermal water which caused the system's thermal resistance to double. If this system is to be viable for this application, a durable, protective coating with a low thermal resistance must be found to prevent both fouling and corrosion. The thermal analysis indicates that up to two hundred of these units can be placed in series with a tolerable degradation in the last unit's performance for water flow rates above 100 GPM. GRA

**N83-12440#** Energy and Environmental Analysis, Inc., Arlington, Va.
**ASSESSMENT OF CURRENT AND PROJECTED FUTURE TRENDS IN LIGHT-DUTY-VEHICLE FUEL SWITCHING. SUBTASK 1**
Jun. 1982 49 p refs
(Contract DE-AC01-78PE-70045)
(DE82-018816; DOE/PE/70045-T3) Avail: NTIS HC A03/MF A01

Trends in fuel switching by motorists during the period 1978 through 1981 were assessed with the use of two data bases of monthly household purchases of gasoline. Fuel switching was defined as either misfueling - the use of leaded gasoline in cars that require unleaded fuel - or discretionary switching - the use of unleaded gasoline in cars which can operate on leaded fuel To identify disaggregated patterns of fuel switching, the data were stratified by year, season, census region, type of service station outlet, vehicle category and vintage. In addition, the relationship of trends in misfueling rates to changes in the relative prices of unleaded and leaded gasoline also were examined. Drawing upon the analysis of current data, three alternative future trends in misfueling rates by vehicle vintage were constructed. The impact of each of these cases on projections of the market share of leaded gasoline was examined with the aid of a previously developed model of highway fuel demand. DOE

**N83-12480#** Department of Energy, Washington, D. C. Office of Basic Energy Sciences.
**SUMMARY OUTLINE OF DOE GEOSCIENCE AND GEOSCIENCE RELATED RESEARCH**
Feb. 1982 110 p
(DE82-008203, DOE/ER-0120) Avail: NTIS HC A06/MF A01

The long range, basic research in the areas of the geosciences relevant to the nation's energy needs are discussed The geoscience program develops a quantitative and predictive understanding of geological, geophysical and geochemical structures and processes in the solid earth and in solar terrestrial relationships An effective knowledge base for energy resurce recognition, evaluation and utilization in an enviromentally acceptable manner is proposed. Principal areas of interest include: geology, geophysics, and Earth dynamics; geochemistry; energy resource recognition, evaluation and utilization; hydrologic and marine sciences and solar terrestrial/atmospheric interactions. DOE

**N83-12541#** Geothermal Power Corp., Novato, Calif
**GEOTHERMAL RESERVOIR ASSESSMENT, ROOSEVELT HOT SPRINGS Final Report, 1 Oct. 1977 - 30 Jun. 1982**
1982 81 p refs
(Contract DE-AC08-77ET-28406)
(DE82-020632; DOE/ET-28406/1) Avail: NTIS HC A05/MF A01

The geology, geophysics, and geothermal potential of the northern Mineral Mountains, located in Beaver and Millard Counties, Utah, are studied More specifically, the commercial geothermal potential of lease holdings of the Geothermal Power Corporation is addressed. DOE

**N83-12571#** California Univ., Livermore. Lawrence Livermore Lab.
**FLUIDIZED-BED PYROLYSIS OF OIL SHALE: OIL YIELD, COMPOSITION, AND KINETICS**
J. H. RICHARDSON, E. B. HUSS, L. L. OTT, J. E. CLARKSON, M O. BISHOP, J R. TAYLOR, L. J. GREGORY, and C. J. MORRIS Sep 1982 72 p refs
(Contract W-7405-ENG-48)
(DE82-021010; UCID-19548) Avail: NTIS HC A04/MF A01

A quartz isothermal fluidized bed reactor was used to measure kinetics and oil properties relevant to surface processing of oil shale. The rate of oil formation was described with two sequential first order rate equations characterized by two rate constants. These rate constants together with an expression for the appropriate weighting coefficients describe approximately 97% of the total oil produced. The results of different attempts to

mathematically describe the data in a manner suitable for modeling applications are related. Preliminary results for species selective kinetics of methane, ethene, ethane and hydrogen, where the latter is clearly distinguished as the product of a distinct intermediate are also presented. Oil yields from Western oil shale are approximately 100% Fischer assay. Oil composition is based on previous work and the higher heating rates inherent in fluidized pyrolysis. Neither the oil yield, composition nor the kinetics varied with particle size between 0.2 and 2 0 mm within experimental error. The qualitatively expected change in oil composition due to cracking was observed over the temperature range studied. Eastern shale exhibited significantly faster kinetics and higher oil yields than did Western shale. DOE

**N83-12584#** Nevada Univ , Reno. Div. of Earth Sciences.
**LOW- TO MODERATE-TEMPERATURE GEOTHERMAL RESOURCE ASSESSMENT FOR NEVADA: AREA SPECIFIC STUDIES, PUMPERNICKEL VALLEY, CARLIN AND MOANA Final Report, 1 Jun. 1981 - 31 Jul. 1982**
D. T. TREXLER, T. FLYNN, B. A KOENIG, E. J. BELL, and G. CHUSN, JR. 1982 197 p refs
(Contract DE-AC08-81NV-10220)
(DE82-018598; DOE/NV-10220/1) Avail: NTIS HC A09/MF A01

Geological, geophysical and geochemical surveys were used in conjunction with temperature gradient hole drilling to assess the geothermal resources in Pumpernickel Valley and Carlin, Nevada. A statewide assessment of geothermal resources that was completed in 1979 was used The exploration techniques are based on previous federally-funded assessment programs that were completed in ix other areas in Nevada and include· literaure search and compilation of existing data, geologic reconnaissance, chemical sampling of thermal and non-thermal fluids, interpretation of satellite imagery, interpretation of low-sun angle aerial photographs, two-meter depth temperature probe survey, gravity survey, seismic survey, soil-mercury survey, and temperature gradient drilling. DOE

**N83-12667#** Acurex Corp., Mountain View, Calif. Energy and Environmental Div
**NEASUREMENT OF HIGH-TEMPERATURE HIGH-PRESSURE PROCESSES: A SUMMARY REPORT Final Report, Sep. 1975 - Sep. 1979**
L. COOPER and M. SHACKLETON Mar. 1982 135 p refs
(Contract EPA-68-02-2153)
(PB82-196932; EPA-600/7-82-009; ORD-79-353) Avail. NTIS HC A07/MF A01 CSCL 13B

An assessment and development of technology required to perform high-temperature high-pressure (HTHP) particulate sampling is summarized. In addition to efforts devoted to developing and testing an HTHP sampler for the EPA/Exxon Miniplant, experience was gained in the design aspects of HTHP sampling equipment and testing procedures. This experience is highlighted. A background study and planning effort was directed toward possible future sampling efforts in a coal gasification plant A state-of-the-art review of HTHP sampling was also performed. To document the materials collected, a bibliography of articles, reports, and books relating to HTHP sampling was compiled A list of persons interested in this technology is also included. Results demonstrated that particle size distribution and samples suitable for chemical analysis can be obtained with the apparatus described in the report. Author (GRA)

**N83-12704#** Texas Univ., Austin. Electrical Geophysics Research Lab
**A MULTI-SITE MAGNETOTELLURIC MEASUREMENT SYSTEM WITH REAL-TIME DATA ANALYSIS Final Technical Report**
J. D. BECKER, F X BOSTICK, and H. W. SMITH Sep. 1981 189 p refs
(Contract DE-AS05-77ET-28341)
(DE82-020596; DOE/ET-28341/T1) Avail: NTIS HC A09/MF A01

A magnetotelluric measurement system was designed to provide a more cost effective electrical method for geothermal and mineral exploration. The theoretical requirements and sensitivities of the magnetotelluric inversion process were specifically addressed in determining system performance requirements. Remotely located, battery powered, instrumentation packages return data to a central controlling site through a 2560 baud wire-line or radio link Each remote package contains preamplifiers, data conditioning filters, and a 12 bit gain ranging A-D converter for frequencies from 0.001 Hz to 8 Hz. Data frequencies above 8 Hz are processed sequentially by a heterodyne receiver to reduce bandwidth to within the limits of the 2560 baud data link. The central data collection site provides overall control for the entire system. Data from the remote packages may be recorded in time sequence on a magnetic tape cartridge system, or an optional Hewlett-Packard 21MX minicomputer can be used to perform real time frequency analysis. The results of this analysis provide feedback to the operator for improved evaluation of system performance and for selection of future measurement sites GRA

**N83-12706#** Oak Ridge Associated Universities, Inc., Washington, D.C. Inst. for Energy Analysis.
**GEOTHERMAL-RESOURCE SURVEY OF THE TENNESSEE VALLEY REGION**
W. P. STAUB and N. L TREAT Aug. 1982 133 p refs
(Contract DE-AC05-76OR-00033)
(DE82-021951, ORAU/IEA-82-7(M)) Avail: NTIS HC A07/MF A01

An overview appraisal of the geothermal resources in the Tennessee Valley Region revealed geothermal resources of potential usefulness in two of 13 subregions· the New Madrid Seismic Zone and the central segment of the Northern Gulf Coastal Plain. The appraisal was based on geologic features of the region (hot springs, groundwater aquifers, and structure) and temperature data for oil and gas wells and shallow water wells. Site specific exploration for economic appraisal was not carried out. The geothermal gradient for each of the subregions was established by linear regression of all of the bottom hole temperature data for the oil and gas wells. A routine statistical procedure identified all unusually warm wells within each subregion, and their locations were plotted Hot spots in a subregion were identified by localized clustering of such wells in numbers exceeding statistical expectations based on the intensity of drilling activity. Of the two areas most likely for extraction of geothermal energy, the New Madrid Seismic Zone has a high geothermal gradient at shallow depths (less than 500 meters). DOE

**N83-12751#** Institut National de la Recherche Agronomique, Avignon (France). Dept. de Bioclimatologie.
**STUDY OF GROUND WINDS IN UPPER VOLTA: ECONOMIC AND AGRONOMIC CONSEQUENCES FOR THE SUDAN-SAHEL REGION OF WEST AFRICA**
C. BALDY, R. DELECOLLE (Direction de la Meteorologie, Upper Volta), and H. KONTONGOMDE *In* WMO Tech. Conf. on Climate: Africa p 325-332 1982 In FRENCH; ENGLISH summary
Avail: NTIS MF A01; print copy available at WMO, Geneva SW FR 35

Ground winds in the cold, dry season (December-January) and the wet season (July) in Upper Volta were analyzed. The utility of windbreaks, and wind energy conversion were studied. Wind velocity alone does not justify the construction of windbreaks, although they could protect crops from blown sand, or prevent water vapor exchange between the protected area and its environment. Winds are regular, with a marked velocity increase

then decrease between 9 am and 5 pm. Even very gentle valleys can reduce wind velocity, so generators should be placed on hilltops, even though irrigation pumps are lower down.
Author (ESA)

**N83-12754#** National Weather Service, Silver Spring, Md. Hydrologic Services Div.
**CLIMATIC ASPECTS OF PLANNING IMPOUNDMENTS AND HYDROPOWER OPERATIONS**
J C. SCHAAKE *In* WMO Tech. Conf. on Climate: Africa p 360-374 1982 refs
Avail: NTIS MF A01; print copy available at WMO, Geneva SW FR 35

The representativeness of past experience of climate for prediction, the sensitivity of streamflow to climate variability, and the social and economic benefits deriving from design or operations decisions for given streamflow conditions are discussed. It is found that future periods exhibit climate conditions that vary from period to period, but these variations can be accounted for on the basis of historical experience augmented by regional analysis of this experience and the use of long term information such as might be found in dendroclimatic studies of tree rings. The representativeness of climate information for the short run requires research to develop quantitative methods. The effect of climate variability on streamflow can be accounted for with conceptual hydrology models, or with a generalized water balance model, or a drought index. Author (ESA)

**N83-12785#** Pacific Northwest Lab., Richland, Wash.
**CANDIDATE WIND-TURBINE-GENERATOR SITE: DATA SUMMARY Annual Report, Jan. - Dec. 1981**
W. F SANDUSKY, J. W. BUCK, D. S. RENNE, D. L. HADLEY, and O. B. ABBEY Jul 1982 298 p refs
(Contract DE-AC06-76RLO-1830)
(DE82-020416; PNL-4283) Avail: NTIS HC A13/MF A01

Summarized hourly meteorological data for 34 candidate and wind turbine generator sites for calendar year 1981 are pesented. These data are collected for the purpose of evaluating the wind energy potential at these sites and are used to assist in selection of potential sites for installation and testing of large wind turbines in electric utility systems For each site, wind speed, direction, and distribution data are given in eight tables. Use of information from these tables, with information about specific wind turbines, should allow the user to estimate the potential for wind energy production at each site. DOE

**N83-12788#** Otawa (Toru), Muncie, Ind.
**DEVELOPMENT OF A SLIDE PROGRAM DESCRIBING A SITE SELECTION PROCESS FOR SMALL WIND-ENERGY-CONVERSION SYSTEMS (SWECS) Final Technical Report**
T. OTAWA May 1982 79 p refs
(Contract DE-FG02-81R-510301)
(DE82-017394; DOE/R5-10301/1-FINAL) Avail: NTIS HC A05/MF A01

A slide program was developed primarily to promote a proper site-selection method for small wind energy conversion systems (SWECS). The technical background of the program development is discussed. The major issues involved in SWECS siting are: wind-resource assessment techniques, land-use constraints, potential hazards, potential environmental impact, site accessibility, and proximity to load location. These factors are incorporated into a method of site-screening to maximize energy output as well as to discourage the negative impact of SWECS siting on the environment. The method utilizes the technique of overlay mapping to analyze different relationships among various patterns of land characteristics. Transparent or semi-transparent maps depicting the patterns are overlaid to show a pattern of light and dark tones revealing areas of site potentials and limitations for SWECS placement. A case-study is conducted to demonstrate the site-selection method developed. DOE

**N83-13005#** Tennessee Univ. Space Inst., Tullahoma. Energy Research and Development Center.
**THREE-DIMENSIONAL CURRENT DISTRIBUTION IN COAL-FIRED MHD CHANNELS**
M. ISHIKAWA, Y. C. L. WU, and M. H. SCOTT Jan. 1982 64 p refs
(Contract DE-AC02-79ET-10815)
(DE82-016958; UTSI-81-6; DOE/ET-10015/70) Avail: NTIS HC A04/MF A01

Slagging effects on theoetical three dimensional current and potential distributions are presented for one frame of the UTSI 600DCW channel. The electrodynamic problem is solved with imposed gasdynamic and slag layer solutions. A three dimensional finite element method was applied to solve for the electrical potential. The location of current concentration calculated on anode sidebar wall coincides with wear patterns observed in experiments. The upper bound of slag layer leakage resistance was calculated. The effects of slag polarization on electrodes and the sidewall configuration on generator performance were investigated. Experimental data reveals that the polarization effect reduces about three percent of the overall electrical performance of the UTSI 600 Diagonal Conducting Wal (DCW) channel. The polarization effect results in a large change of the potential and current distributions near the frame but has a small effect on the overall electrical performance. Alternate sidewall/electrode configurations are considered analytically. DOE

**N83-13041#** Weston (Roy F.), Inc., West Chester, Pa.
**DEMONSTRATION OF SYNERGISTIC INDUSTRIAL ENERGY/MUNICIPAL SOLID WASTE DISPOSAL FACILITY**
Sep. 1981 164 p Prepared in cooperation with County of Delaware, Media, Pa. and Scott Paper Co., Chester 3 Vol.
(Contract DE-FG01-79CS-20245)
(DE82-001145; DOE/CS-20245/2-VOL-1) Avail: NTIS HC A08/MF A01

The completion of Phase 1 of the Demonstration of Synergistic Industrial Energy/Municipal Solid Waste Disposal Facility is discussed. The opportunities available to recover material and energy resources from solid waste, both within and outside the County boundaries are discussed. The general engineering concepts necessary to achieve successful resource recovery are discussed Preliminary cost estimates, technical evaluations, and economic analyses are presented. A recommendation for selecting specific resource recovery concepts is given, and a recommended work plan for the next phase of the study is presented. DOE

**N83-13089#** National Telecommunications and Information Administration, Boulder, Colo. Institute for Telecommunication Sciences.
**INSTRUMENT LANDING SYSTEM LOCALIZER RECEIVER PERFORMANCE IN THE PRESENCE OF CO-CHANNEL INTERFERENCE Final Report**
E. J. HAAKINSON Jul. 1982 51 p
(Contract DT-FA01-81-Y-10534)
(AD-A118909; DOT/FAA/RD-82/43) Avail: NTIS HC A04/MF A01 CSCL 17G

Co-channel signals can cause harmful interference to navigational aid systems such as the Instrument Landing System. This report describes the performance of four localizer receivers in the presence of interference from co-channel CW (Continuous Wave), PSK (Phase Shift Keying), FSK (Frequency Shift Keying), and FM (Frequency Modulation) signals. The receiver parameters monitored during the measurements were course deviation voltage, warning flag voltage, AGC (Automatic Gain Control) voltage, and audio distortion. Measurement results are reported as the minimum signal-to-interference ratio required to keep each monitored parameter from exceeding specified bounds. Course deviation voltage is the most sensitive parameter to the co-channel interference. GRA

**N83-13197#** Brookhaven National Lab., Upton, N. Y.
**FLASH HYDROPYROLYSIS OF COAL FOR CONVERSION TO LIQUID AND GASEOUS FUELS**
M. S. SUNDARAM, M. STEINBERG, and P. T. FALLON May 1982 97 p refs
(Contract DE-AC02-76CH-00016)
(DE82-019435; DOE/METC-82-48) Avail: NTIS HC A05/MF A01

Process chemistry and design information for production of both liquid and gaseous fuels from coal was obtained In particular, the products and correlation of the product yields as a function of pressure, temperature, and coal residence time in the flash hydropyrolyzer, was performed, and then this information was combined with the kinetic data to develop a reaction model. A parametric study of the flash hydropyrolysis was made with different coal types. Appropriate reactor conditions for maximizing either liquid or gaseous products were determined The components in the heavier liquids were identified, and nitrogen and sulfur balances were made on the coal, the char products, and both the liquid and the gaseous effluents. From a detailed analysis of data, a reaction scheme for the flash hydropyrolysis of coal was proposed, for which reaction rate constants were determined and a kinetic model was developed. This information was applied to a conceptual full scale process design, and comparative economic estimates were made. The results indicate that the coals tested can be successfully converted to produce clean gaseous and liquid fuels via flash hydropyrolysis. Two features of this process - its being noncatalytic and its using direct hydrogenation in one step to liquid distillates - tend to improve the efficiency and reduce capital and operating costs. The process can be made to produce either gaseous or liquid fuels, or both, by adjusting the reactor and process design conditions. DOE

**N83-13240#** Oak Ridge National Lab., Tenn.
**STRESS-CORROSION STUDIES IN COAL-LIQUEFACTION ENVIRONMENTS**
V. B BAYLOR, J R. KEISER, and J. H. DEVAN 1981 10 p refs Presented at the 6th Ann. Conf. on Materials for Coal Conversion and Utilization, Gaithersburg, Md., 13 Oct. 1981
(Contract W-7404-ENG-26)
(DE82-001464; CONF-811061-1) Avail: NTIS HC A02/MF A01

Over 300 U bend specimens from all four coal liquefaction pilot plants were examined by determining corrosion rates as well as by visual and metallographic analysis. Sulfur containing acids were studied. Results from U bend exposures in coal liquefaction pilot plants show that in the reactor and separator areas general corrosion and possibly some cracking of low alloy steels, sulfidation of nickel base alloys, cracking of some austenitic steels and generally good performance of stabilized austenitic, high alloy austenitic, duplex, ferritic austenitic, and ferritic stainless steels takes place. In the fractionation area extensive general corrosion and pitting of low alloy and stainless steels was found, with corrosion performance improving with higher nickel alloys (as with alloy 825). DOE

**N83-13272*#** Pennsylvania State Univ., University Park. Center for Air Environment Studies
**FUMIGATION OF ALCOHOL IN A LIGHT DUTY AUTOMOTIVE DIESEL ENGINE Final Report**
E. M. H. BROUKHIYAN and S. S. LESTZ Aug. 1981 121 p refs
(Contract NAG3-91; DE-AI01-81CS-50006)
(NASA-CR-167915; DOE/NASA/0091-1; NAS 1.26:167915; CAES-600-81) Avail. NTIS HC A06/MF A01 CSCL 21D

A light-duty automotive Diesel engine was fumigated with methanol in amounts up to 35% and 50% of the total fuel energy respectively in order to determine the effect of alcohol fumigation on engine performance at various operating conditons. Engine fuel efficiency, emissions, smoke, and the occurrence of severe knock were the parameters used to evaluate performance. Raw exhaust particulate and its soluble organic extract were screened for biological activity using the Ames Salmonella typhimurium assay Results are given for a test matrix made up of twelve steady-state operating conditions. For all conditions except the 1/4 rack (light load) condition, modest thermal efficiency gains were noted upon ethanol fumigation. Methanol showed the same increase at 3/4 and full rack (high load) conditions. However, engine roughness or the occurrence of severe knock limited the maximum amount of alcohol that could be fumigated. Brake specific nitrogen oxide concentrations were found to decrease for all ethanol conditions tested Oxides of nitrogen emissions, on a volume basis, decreased for all alcohol conditions tested. Based on the limited particulate data analyzed, it appears that ethanol fumigation, like methanol fumigation, while lowering the mass of particulated emitted, does enhance the biological activity of that particulate. Author

**N83-13277#** Wisconsin Univ., Madison
**ALCOHOL AS A FUEL FOR FARM AND CONSTRUCTION EQUIPMENT**
G. L. BORMAN, D. E. FOSTER, P S. MEYERS, O. A. UYEHARA, J. CHEN, X. GAO, and Z. YE Jun. 1982 33 p refs
(Contract DE-AC02-79CS-50025)
(DE82-021022, DOE/CS-50025/2) Avail: NTIS HC A03/MF A01

Work in three areas dealing with the utilization of ethanol as fuel for farm and construction diesels is summarized What is known about the retrofitting of diesels for use of ethanol and the combustion problems involved is reviewed. The performance of a single cylinder, open chamber diesel using solutions and emulsions of diesel fuel with ethanol is described. Data taken include performance, emissions and cylinder pressure-time for diesel fuel with zero to forty percent ethanol by volume. Analysis of the data includes calculation of heat release rates using a single zone model. An investigation into retrofitting a multicylinder turbocharged farm tractor diesel to use ethanol by fumigation is discussed. Three methods of ethanol introduction are discussed; spraying ethanol upstream and downstream of the compressor and prevaporization of the ethanol Data on performance and emissions are given for the last two methods A three zone heat release model is described and results from the model are given. A correlation of the ignition delay using prevaporized ethanol fumigation data is also given. Comparisons are made between fumigation in DI and IDI engines. DOE

**N83-13279#** TRW, Inc., Redondo Beach, Calif. Environmental Div
**A COMPENDIUM OF SYNFUEL END USE TESTING PROGRAMS Final Report, Mar. - Sep. 1981**
M. GHASSEMI, S. QUINLIVAN, and M. HARO May 1982 237 p refs
(Contract EPA-68-02-3174)
(PB82-236936, EPA-600/7-82-035) Avail: NTIS HC A11/MF A01 CSCL 07A

Information on major, recently completed, current, and planned synfuel end-use testing projects is given. It is intended to promote the flow of information between synfuel testing programs, thereby reducing the duplication of effort and enabling design and implementation of cost-effective and systematic approaches to the collection of appropriate environmental data in conjunction with on-going and planned performance testing projects. Projects described in the compendium include testing of shale-derived fuels, middle distillates, coal liquids, and methanol/indolene mixtures in such equipment as utility boilers, steam generators, diesel engines (laboratory and full scale), auto engines, and other combustors GRA

**N83-13280#** Radian Corp., McLean, Va.
**SOURCE TEST AND EVALUATION REPORT: ALCOHOL FACILITY FOR GASOHOL PRODUCTION Final Report, Oct. 1979 - Feb. 1980**
R. M. SCARBERRY, M. P. PAPAI, P. E. MILLS, and T. J. POWERS, III Apr. 1982 199 p refs
(Contract EPA-68-02-2667)
(PB82-237041, EPA-600/7-82-018) Avail: NTIS HC A09/MF A01 CSCL 07A

The requirements for environmental sampling and analysis of alcohol-producing facilities capable of supporting a gasohol industry are defined and these requirements are applied to the environmental characterization of an alcohol plant. A conceptual design of a grain alcohol plant using a coal-fired boiler that is projected to be typical of future plants which will support a Gasohol industry is given Environmental control options are also discussed based on a comparison of alcohol plant stream compositions with environmental regulations. The results of this study provide preliminary information on the environmental consequences of large-scale fermentation ethanol plants which will provide alcohol for gasohol. GRA

**N83-13281#** Southwest Research Inst., San Antonio, Tex.
**CHARACTERIZATION OF DIESEL EMISSIONS FROM OPERATION OF A LIGHT-DUTY DIESEL VEHICLE ON ALTERNATE SOURCE DIESEL FUELS**
B. B. BYKOWSKI Nov. 1981 74 p refs
(Contract EPA-68-03-2884)
(PB82-232448; EPA-460/3-82-002) Avail: NTIS HC A04/MF A01 CSCL 21D

Emission evaluations of several alternate-source fuels in a 1980 Volkswagen Rabbit Diesel are described. Fuels tested included a no. 2 petroleum diesel as base, base plus coal derived liquids, shale oil diesel fuel and jet fuel, and a blend of petroleum blend stocks with coal and shale liquids Nine fuels were investigated including the base fuel. GRA

**N83-13282#** Southwest Research Inst., San Antonio, Tex.
**CHARACTERIZATION OF DIESEL EMISSIONS FROM OPERATION OF A LIGHT-DUTY DIESEL VEHICLE ON ALTERNATE SOURCE DIESEL FUELS Final Report, Jun. 1980 - Oct. 1981**
B. B. BYKOWSKI Nov. 1981 190 p refs
(Contract EPA-68-03-2884)
(PB82-234147; EPA-460/3-82-002) Avail: NTIS HC A09/MF A01 CSCL 21D

Alternate source diesel test fuels and their effects on regulated and unregulated exhaust emissions from a 1980 Volkswagen Rabbit were examined. Nine fuel blends were tested: a no. 2 petroleum diesel as base, base plus coal derived liquids, shale oil diesel and jet fuel, and other blends of coal derived liquids, shale oil liquids, and petroleum stocks Analyses performed include gaseous hydrocarbons, CO, NOx, particulate mass, phenols, smoke, odor, Ames tests, BaP, and polarity by HPLC. Smoke and particulate increases are generally associated with use of coal derived liquids. GRA

**N83-13283#** Gulf South Research Inst., New Orleans, La.
**COMPONENTS IDENTIFIED IN ENERGY-RELATED WASTES AND EFFLUENTS Final Report, Nov. 1976 - Nov. 1979**
J. E. GEBHART and M. M. MCKOWN May 1982 734 p refs
(Contract EPA-68-03-2487)
(PB82-236985; EPA-600/3-82-058) Avail: NTIS HC A99/MF A01 CSCL 21D

A state-of-the-art review of the characterization of solid wastes and aqueous effluents generated by energy-related processes was conducted. The reliability of these data was evaluated according to preselected criteria of sample source, sampling and analytical methodology, and data source. Data on the following activities were included: coal strip mining, oil refineries, oil shale operations, coal-fired power plants, coal liquefaction processes, coal gasification processes, and geothermal energy production. Using the information collected, areas of inadequate data were identified and sampling sites were selected. Sites were selected to include at least one plant in each of seven energy-related activities. Absorption spectroscopy and mass spectroscopy were employed. Author (GRA)

**N83-13284#** Texas Engineering Experiment Station, College Station.
**BASIC RESEARCH OPPORTUNITIES FOR LASTING FUEL GAS SUPPLIES FROM INORGANIC RESOURCES. REPORT OF A WORKSHOP COLLEGE STATION, 8 JUN. - 14 AUG. 1981 Final Report, 15 Feb. 1981 - 28 Feb. 1982**
K. J. IRGOLIC, ed. 28 Feb. 1982 335 p refs Workshop held at College Station, Tex., 8 Jun. - 14 Aug. 1981
(Contract GRI-5081-360-0435)
(PB82-231671, GRI-81/0024) Avail: NTIS HC A15/MF A01 CSCL 21D

The production of fuel gases from inorganic resources using indefinitely sustainable energy sources were studied. Photobiological, biomimetic, photochemical, photoelectrochemical, radiolytic and thermochemical pathways leading to the generation of hydrogen from water and hydrogen sulfide, of carbon monoxide and methane from carbon dioxide, and of nitrogen-based fuel gases from atmospheric nitrogen were assessed. The most likely energy sources to drive the endergonic, fuel-producing reactions are solar radiation, and heat and radiation from nuclear reactors. GRA

**N83-13378#** Vereinigte Elektrizitaetswerke Westfalen A G., Dortmund (West Germany). Hauptbereich Maschinentech.
**BASIC ENGINEERING OF A 10 T/HR PROTOTYPE PLANT FOR THE VEREINIGTE ELEKTRIZITAETSWERKE WESTFALEN (VEW) COAL CONVERSION PROCESS Final Report, Nov. 1981**
K. WEINZIERL, D DEGGIM, J. POLLER, and R. KARGER Bonn Bundesministerium fuer Forschung und Technologie Aug. 1982 111 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-114; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 23,50

A coal conversion process and prototype plants are described. The prototype plant consists of the gasification unit with coal milling and drying, the coal feeding, the waste heat recovery and gas/char separation unit and the gas cleaning unit with the gas cooling, the H2S removal, and the evaporation and sulfur production units. Author (ESA)

**N83-13464#** Curtiss-Wright Corp., Wood-Ridge, N.J. Power Systems Div.
**HIGH-TEMPERATURE-TURBINE-TECHNOLOGY PROGRAM. PHASE 2: TECHNOLOGY TEST AND SUPPORT STUDIES. TURBINE SPOOL TECHNOLOGY RIG FUEL-CONTAMINANT TOLERANCE TEST**
Apr. 1982 105 p
(Contract DE-AC01-76ET-10348)
(DE82-020287; CW-WR-76-020.98A; FE-2291-98A) Avail: NTIS HC A06/MF A01

The durability of high temperature transpiration air cooled turbine blading under increasingly severe conditions simulating the combustion of coal derived was investigated. The test equipment, procedures and results are described. The high pressure ratio and mass flow of the TSTR produced turbine section particulate loading about twice that of the LP rig engine. The durability of this new transpiration air cooled blading to be comparable to that of the LP rig engine is shown. DOE

**N83-13552#** Bendix Field Engineering Corp., Grand Junction, Colo.
**HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR UTICA QUADRANGLE, NEW YORK. URANIUM RESOURCE EVALUATION PROJECT**
7 Jun. 1982 95 p Prepared in cooperation with Oak Ridge Gaseous Diffusion Plant
(Contract DE-AC13-76GJ-01664, W-7405-ENG-26)
(DE82-020429; GJBX-85-82; K/UR-440) Avail: NTIS HC A05/MF A01

Hydrogeochemical data which were compiled for stream sediment reconnaissance of Utica quadrangle in New York are presented. DOE

**N83-13553#** Bendix Field Engineering Corp., Grand Junction, Colo.
**HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR MARION, CANTON, PITTSBURGH AND CLEVELAND QUADRANGLES, OHIO; WEST VIRGINIA; PENNSYLVANIA. URANIUM RESOURCE EVALUATION PROJECT**
7 Jun. 1982 61 p Prepared in cooperation with Oak Ridge Gaseous Diffusion Plant
(Contract DE-AC13-76G-01664; W-7405-ENG-26)
(DE82-020430; GJBX-80-82; K/UR-435) Avail: NTIS HC A04/MF A01

Data were compiled for the hydrogeochemical and stream sediment reconnaissance of Marion, Canton, Pittsburgh, and Cleveland quadrangles of Ohio, West Virginia, and Pennsylvania. DOE

**N83-13554#** Bendix Field Engineering Corp., Grand Junction, Colo.
**HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR BEAUMONT, LAKE CHARLES AND BATON ROUGE QUADRANGLES, TEXAS; LOUISIANA. URANIUM RESOURCE EVALUATION PROJECT**
7 Jun. 1982 21 p Prepared in cooperation with Oak Ridge Gaseous Diffusion Plant
(Contract DE-AC13-76GJ-01664; W-7405-ENG-26)
(DE82-020438; GJBX-66-82; K/UR-421) Avail: NTIS HC A02/MF A01

Hydrogeochemical data were compiled for stream sediment reconnaissance of Beaumont, Lake Charles, and Baton Rouge quadrangles in Texas and Louisiana. DOE

**N83-13557#** Bendix Field Engineering Corp., Grand Junction, Colo
**HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR OGDENSBURG AND LAKE CHAMPLAIN QUADRANGLES, NEW YORK; VERMONT. URANIUM RESOURCE EVALUATION PROJECT**
9 Jun. 1982 75 p Prepared in cooperation with Oak Ridge Gaseous Diffusion Plant
(Contract DE-AC13-76GJ-01664; W-7405-ENG-26)
(DE82-020417; GJBX-87-82; K/UR-442) Avail: NTIS HC A04/MF A01

Hydrogeochemical data which were compiled for stream sediment reconnaissance of Ogdensburg and Lake Champlain quadrangles in New York and Vermont are presented. DOE

**N83-13558#** Bendix Field Engineering Corp., Grand Junction, Colo.
**HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR JENKINS QUADRANGLE, KENTUCKY; VIRGINIA; WEST VIRGINIA. URANIUM RESOURCE EVALUATION PROJECT**
3 Jun. 1982 96 p
(Contract DE-AC13-76GJ-01664; W-7405-ENG-26)
(DE82-020431; GJBX-78-82; K/UR-433) Avail: NTIS HC A05/MF A01

Hydrogeochemical data which were compiled for the stream sediment reconnaissance of Virginia, West Virginia, and Jenkins Quadrangle in Kentucky are presented. DOE

**N83-13559#** Bendix Field Engineering Corp., Grand Junction, Colo.
**HYDROGEOCHEMICAL AND STREAM-SEDIMENT RECONNAISSANCE BASIC DATA FOR SHERMAN, TAXARKANA, EL DORADO, AND GREENWOOD QUADRANGLES, OKLAHOMA; TEXAS; ARKANSAS; MISSISSIPPI**
9 Jun. 1982 95 p
(Contract DE-AC13-76GJ-01664; W-7405-ENG-26)
(DE82-020436; GJBX-69-82; K/UR-424) Avail: NTIS HC A05/MF A01

Data which were compiled for the hydrogeochemical and stream-sediment reconnaissance of Sherman, Texarkana, El Dorado, and Greenwood quadrangles in Oklahoma, Texas, Arkansas, and Mississippi are presented. DOE

**N83-13588*#** General Electric Co., Schenectady, N. Y.
**EVALUATION OF CATALYTIC COMBUSTION OF ACTUAL COAL-DERIVED GAS Final Report**
J. C. BLANTON and R A. SHISLER Feb. 1982 54 p refs
(Contract NAS3-22818, DE-AI01-77ET-10350)
(NASA-CR-167842; DOE/NASA-2818-1; NAS 1.26:167842; SRD-82-023) Avail: NTIS HC A04/MF A01 CSCL 21B

The combustion characteristics of a Pt-Pl catalytic reactor burning coal-derived, low-Btu gas were investigated A large matrix of test conditions was explored involving variations in fuel/air inlet temperature and velocity, reactor pressure, and combustor exit temperature. Other data recorded included fuel gas composition, reactor temperatures, and exhaust emissions. Operating experience with the reactor was satisfactory. Combustion efficiencies were quite high (over 95 percent) over most of the operating range. Emissions of NOx were quite high (up to 500 ppm V and greater), owing to the high ammonia content of the fuel gas. Author

**N83-13601#** Battelle Columbus Labs., Ohio.
**CONVERSION OF FOREST RESIDUES TO A METHANE-RICH GAS IN A HIGH-THROUGHPUT GASIFIER**
H. F. FELDMAN, M A. PAISLEY, D W. FOLSOM, and B C. KIM
31 Oct. 1981 60 p refs
(Contract W-7405-ENG-92)
(DE82-020289; BMI-2907) Avail: NTIS HC A04/MF A01

Results of the experimental work conducted thus far show that wood can be readily gasified in a steam environment into a hydrocarbon rich fuel gas that can be used as a replacement for petroleum based fuels or natural gas with minimal boiler retrofit. Further, this conversion can be achieved in a compact gasification reactor with heat supplied by a circulating entrained phase, thereby eliminating the need for an oxygen plant. Tars were found except at the lowest gasifier temperatures employed, and therefore heat recovery from the product gas should be much simpler than that from commercially available fixed bed gasification systems where product gas contains significant quantities of tar. The data generated were used in a preliminary conceptual design. Evaluation of this design shows that a medium Btu gas can be produced from wood at a cost competitive with natural gas or petroleum based fuels. DOE

**N83-13602#** Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.
**DEVELOPMENT OF GEOTHERMAL BINARY-CYCLE WORKING-FLUID PROPERTIES: INFORMATION AND ANALYSIS OF CYCLES Final Report**
K. E. STARLING, Z. I. MALIK, and C. T CHU 30 Sep. 1981 7 p refs
(DE82-021542; DOE/ID-01719/5) Avail. NTIS HC A02/MF A01

Efforts were directed principally to the following tasks: (1) comparisons of mixture and pure fluid cascade cycles, (2) development of guidelines for working fluid selection for single boiler cycles, (3) continued evaluation of mixtures as working fluids, (4) working fluid thermophysical property correlation and

presentation of properties information, (5) support to the INEL Conversion Technology Program. DOE

**N83-13605#** Great Plains Gasification Association, Detroit, Mich.
**GREAT PLAINS GASIFICATION PROJECT Technical Progress Report, quarter ending 30 Jun. 1982**
30 Jul. 1981 61 p
(Contract DE-FM02-82FE-55014)
(DE82-019500; DOE/FE-55014/T1) Avail: NTIS HC A04/MF A01

For the quarter ending June 30, 1982, engineering was on schedule for the Mine and slightly behind schedule for the Plant. There are no major engineering problems which would foreseeably impact the scheduled start up date for production. There were no major engineering changes for the quarter which would affect the technical baseline. Engineering for the next quarter will be directed to supporting the remaining portion of the summer construction schedule, completing the civil/structural design work, maintaining a high level of production for piping drawings and making significant progress in the electrical/instrument areas. DOE

**N83-13629#** Centro Informazioni Studi Esperienze, Milan (Italy). Documentation Service.
**EXPERIMENTAL RESULTS OF A NONCONVENTIONAL ENERGY CONVERSION PILOT FACILITY-THERMOGRAVIMETRIC SYSTEM**
S. AROSIO (Politec. di Milan), M. BALESTRI (Ente Nazl. per l'Energia Elect., Pisa, Italy), F. BONFANTI, and G. SOTGIA (Politec. di Milan) 1981 20 p refs Presented at 4th Intern. Conf. on Alternative Energy Sources, Miami, 14-16 Dec. 1981
(Contract ENEL-39/600)
(CISE-1754) Avail: NTIS HC A02/MF A01

The experimental analysis of a freon-water two-phase thermogravimetric pilot plant is presented. A comparison with mathematical models, developed for the determination of the geometric characteristics, component sizing, and off design performances of the thermogravimetric systems are also delineated. The pilot plant instrumentation and data acquisition system are described. A subroutine supplies the partial balance of the various plant components, the overall energy balance of the whole system and a preliminary analysis of the main characteristics of the two-phase flow. Curves showing the output power as a function of the actual design ratios of freon flow and hydraulic pressure drop are presented. The flow dynamic characteristics of the two-phase mixture are discussed. Author (ESA)

**N83-13631#** Massachusetts Inst. of Tech., Cambridge. Energy Lab
**ESTIMATION OF RESOURCE AND RESERVES Final Report**
M. A. ADELMAN, J. C. HOUGHTON, G. KAUFMAN, and M. ZIMMERMAN Mar. 1982 533 p refs Sponsored in part by Electric Power Research Inst.
(PB82-230954; MIT/EL-82-010) Avail: NTIS HC A23/MF A01 CSCL 10A

The economics of resource and reserve estimation are analyzed. The economic theory of natural resources and exhaustible resources are discussed. The measurement of already discovered deposits, undiscovered deposits, coal resource and reserve estimation, uranium, and a cumulative cost curve are also discussed. Author (GRA)

**N83-13636#** Bureau of Mines, Denver, Colo. Research Center.
**EVALUATION OF A SHEATHED PERMISSIBLE EXPLOSIVE CHARGE FOR OPEN SHOOTING IN FLAMMABLE ATMOSPHERES: ADOBE CHARGE PROGRAM Technical Progress Report**
R. J. MAINIERO and J. E. HAY Apr. 1982 14 p
(PB82-220732; BM-TPR-118) Avail. NTIS HC A02/MF A01 CSCL 08I

A prototype nonincendive explosive rock-breaker charge that can be fired unconfined in underground bituminous coal mines without the danger of igniting a flammable atmosphere that might be present is described. At present, unconfined shooting in underground coal mines is prohibited, but there are situations where the use of such shots would yield an overall improvement in safety. The charge consists of 1-1/2 lb of permissible water gel explosive in the form of a short cylinder 7 inches in diameter and 7/8 inches high, surrounded by a 1/2-inch-thick layer of damp salt, and encased in latex rubber reinforced with cheese cloth. The latex rubber housing provides a charge package that is strong enough to resist rough handling yet is pliable enough to conform to an irregular stone surface. A charge of this shape was found to be more effective at breaking rock than charges with lined or unlined cavities. GRA

**N83-13650#** Oak Ridge National Lab., Tenn.
**ANALYSIS OF TREATED SLUDGES AND ASSOCIATED LEACHATES FROM COAL-CONVERSION FACILITIES**
M. P. MASKARINEC, D. K. BROWN, R. S. BRAZELL, and R. W. HARVEY 1981 21 p refs Presented at Natl. Am. Chem. Soc. Summer Meeting, N. Y., 23 Aug. 1981
(Contract W-7405-ENG-26)
(DE82-001488; CONF-810813-14) Avail: NTIS HC A02/MF A01

The classification of a solid waste as to degree of hazard involves the qualitative and quantitative analysis of potentially toxic materials in the waste and, subsequently, determination of the mobility of these materials in the environment. Analytical methods for organic compounds in coal conversion solid wastes are developed, as well as procedures or assessing the mobility of these compounds in the environment. Analytical methods for solid wastes and sludges are divided into two categories: (1) extraction of organics from the sample, and (2) determination of the individual components in the extraction is crucial to the reliability of the analytical data. Methods such as Soxhlet extraction (1), ultrasonic extraction (2) steam distillation (3), and three phase extraction systems were used for the analysis of target compounds in solid wastes. DOE

**N83-13673#** Acurex Corp., Morrisville, N.C.
**PILOT-SCALE ASSESSEMENT OF CONVENTIONAL PARTICULATE CONTROL TECHNOLOGY FOR PRESSURIZED FLUIDIZED-BED COMBUSTION EMISSIONS Final Report, Mar. 1979 - Jun. 1980**
W. O. LIPSCOMB, III, S. R. MALANNI, C. L. STANLEY, and S. P. SCHLIESSER Apr. 1982 132 p refs
(Contract EPA-68-02-2646)
(PB82-230921; EPA-600/7-82-028) Avail: NTIS HC A07/MF A01 CSCL 13B

Results of an evaluation of electrostatic precipitator (ESP) and fabric filter particulate control technology for the EPA/Exxon pressurized fluidized bed combustion (PFBC) Miniplant in Linden, NJ are given. EPA's mobile ESP and fabric filter pilot facilities were slip streamed downstream of the Miniplant's tertiary cyclone to simulate the flue gas stream exiting a PFBC combined cycle gas turbine. Results presented include control device operating charactenstics and performance based on mass and fractional collection efficiencies. Author (GRA)

**N83-13694#** North Dakota Geological Survey, Grand Forks.
**COMPUTER MANAGEMENT OF GEOLOGIC AND PETROLEUM DATA AT THE NORTH DAKOTA GEOLOGICAL SURVEY**
K. L. HARRIS, L. M. WINCZEWSKI, and H. R. UMPHREY 1982 37 p refs
(DE82-904385; NP-2905271; REPT-74) Avail: NTIS HC A03/MF A01

A map-oriented data management system, GEOSTOR, is described. General and specific design criteria are discussed in addition to the data elements, coordinate systems, and data entry and retrieval. DOE

**N83-13695#** Research Inst of National Defence, Stockholm (Sweden).
**SEISMOLOGY, 1981, NUCLEAR TEST BAN VERIFICATION. EARTHQUAKE AND EARTH RESOURCE INVESTIGATION Progress Report, 1981**
Jul 1982 91 p refs
(FOA-C-20460-T1) Avail. NTIS HC A05/MF A01

Seismological projects, including nuclear explosion monitoring, the development of international data centers, seismic risk estimation for nuclear power plants, oil exploration using seismic methods, and crystalline rock investigation using seismic cross hole measurements are reported on. In 1981, France conducted 11 nuclear tests, Britain 1, the US 16, and the USSR 21. The explosions were within the 150 kton limit. Author (ESA)

**N83-13975#** Commissariat a l'Energie Atomique, Paris (France).
**NUCLEAR FUEL CYCLE AND WASTE MANAGEMENT IN FRANCE**
Y SOUSSELIER May 1981 9 p Presented at the Intern. Conf. on Computing in Civil Eng., New York, 11-15 May 1981
(DE81-700732, CEA-CONF-5721; CONF-810517-2) Avail: NTIS (US Sales Only) HC A02/MF A01; DOE Depository Libraries

After a short description of the nuclear fuel cycle mining, milling, enrichment and reprocessing, radioactive waste management in France is exposed. The different types of radioactive wastes are examined. Storage, solidification and safe disposal of these wastes are described. DOE

**N83-14165#** Naval Research Lab, Washington, D C.
**PYROLYSIS OF ORGANIC COMPOUNDS CONTAINING LONG UNBRANCHED ALKYL GROUPS Final Report**
G. W MUSHRUSH and R. N HAZLETT 21 Sep. 1982 30 p refs
(Contract WR0240201)
(AD-A119749; NRL-8630) Avail: NTIS HC A03/MF A01 CSCL 07D

The presence of n-alkanes in jet fuel in the right distillation range can be explained if large n-alkanes are present in the crude-oil source. Quantities of large n-alkanes present in crudes made from shale are insufficient, however, to explain the amounts found (up to 37%) in the jet fuel made from these crudes. Although possible precursors to small straight chain molecules are branch alicyclic compounds or substituted cyclic compounds, this report shows that attack in the side chain of model aromatic compounds typically found in shale crudes affords a path to significant yields of n-alkanes. Primary attack at the alpha and gamma positions is favored for substituted benzenes and pyridines. The major initial product distribution can be explained on the basis of Fabuss-Smith-Satterfield theory Author (GRA)

**N83-14178#** Centec Consultants, Inc., Reston, Va. Office of Industrial Programs.
**PROGRAM GUIDE TO USED OIL RECYCLING**
Jan. 1982 40 p refs Supersedes DOE/CS-0015
(Contract DE-AC01-80CS-40402)
(DOE/CS-40402/1; DOE/CS-0015) Avail. NTIS HC A03/MF A01

Information necessary to organize a used oil recycling program, establish collection points, and enlist the cooperation of concerned individuals and civic minded groups is presented. Emphasis is placed on salvaging a valuable energy resource and reducing environmental pollution caused by indiscriminate dumping and uncontrolled burning. J.M.S

**N83-14189#** Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
**INSTALLATION OF A DIESEL ENGINE COMBUSTION/IGNITION EVALUATION FACILITY Interim Report, Oct. 1980 - Sep. 1981**
D. M. YOST, T. W. RYAN, III, and E. C. OWENS Dec. 1981 72 p refs
(Contract DAAK70-80-C-0001; DAAK70-82-C-0001; DA PROJ. 1L7-62733-AH-20)
(AD-A119610; AFLRL-152; SWRI-6800-123) Avail: NTIS HC A04/MF A01 CSCL 21G

A facility for examining shale fuel property-related combustion/ignition effects on diesel engine performance has been installed at the U.S. Army Fuels and Lubricants Research Laboratory (AFLRL). The facility consists of a single-cylinder conversion of a three-cylinder, two-stroke cycle engine, an engine instrumentation package for determining combustion efficiencies, and a dedicated system for rapid data acquisition. The computer system and software has been developed with the flexibility to expand into other areas of fuels and combustion research. The facility will be an effective tool in the continuing development of Army mobility fuels. Author (GRA)

**N83-14192#** Wisconsin Univ., Madison. Dept. of Mechanical Engineering
**DIESEL COMBUSTION ANALYSIS USING RAPID SAMPLING TECHNIQUES Final Report, Jul. 1978 - Jul. 1982**
G. L BORMAN, P. S. MYERS, and C. A. UYEHARA Aug. 1982 13 p refs
(Contract DAAG29-80-C-0129; DAAG29-78-G-0146)
(AD-A119658, ARO-14251.3-EG; ARO-15788.3-EG) Avail. NTIS HC A02/MF A01 CSCL 21G

The purpose of the research was to obtain a better understanding of the fundamental processes which take place in a diesel cylinder during combustion. A single cylinder, open chamber engine with a special head designed to allow in-cylinder sampling was used for the research. Using a conventional injector, two kinds of sampling projects were carried out; timed sampling of small local samples using a probe and total cylinder sampling, achieved by suddenly expanding and transferring 80% of the cylinder content to a quench chamber. A third study used an electronic fuel injection system to study the effects of injection parameters on performance, heat release, ignition delay and exhaust emissions. GRA

**N83-14197#** Los Alamos Scientific Lab., N. Mex.
**LASER-ISOTOPE-SEPARATION TECHNOLOGY**
R. J. JENSEN and L S BLAIR 1981 8 p Presented at the Ind. US/Japan Conf. on Laser Mater. Process, Anaheim, Calif., 16-17 Nov. 1981
(Contract W-7405-ENG-36)
(DE81-030114; LA-UR-81-2423-REV; CONF-811116-1-REV) Avail: NTIS HC A02/MF A01

The Molecular Laser Isotope Separation (MLIS) process is discussed as an operative example of the use of lasers for material processing. The MLIS process, which uses infrared and ultraviolet lasers to process uranium hexafluoride (UF6) resulting in enriched uranium fuel to be used in electrical-power-producing nuclear reactor, is reviewed. The economics of the MLIS enrichment process is compared with conventional enrichment technique, and the projected availability of MLIS enrichment capability is related to estimated demands for U.S. enrichment service. The lasers required in the Los Alamos MLIS program are discussed in detail, and their performance and operational characteristics are summarized. Finally, the timely development of low-cost, highly efficient ultraviolet and infrared lasers is shown to be the critical element controlling the ultimate deployment of MLIS uranium enrichment. DOE

**N83-14198#** Stanford Univ., Calif. High Temperature Gasdynamics Lab
**PULVERIZED COAL COMBUSTION Semiannual Report, 1 Apr. - 30 Sep. 1981**
M. JOST, I LESLIE, and C. H. KRUGER Oct. 1981 30 p refs
(Contract DE-AC22-80PC-30177)
(DE82-002969; DOE/PC-30177-2; HTGL-127/48) Avail: NTIS HC A03/MF A01

A flow tube reactor for the study of the reactivity of pulverized coal under controlled conditions has been developed at Stanford University. The reactor system incorporates optical diagnostics as well as probe sampling techniques to measure the reactivity of coals with differing physical and chemical properties. The aim of the research is to provide fundamental data that can be used in the design and development of coal combustion systems. Several major improvements have recently been made on the flow tube reactor. These changes result in more flexibility in controlling the fluid mechanics, more extensive data gathering capabilities for the diagnostics, and higher data rates. Both diffusionally and kinetically controlled reactivity limits have been found in our Montana Rosebud coal experiments. Surface reactivity was not always found to increase with gas temperature DOE

**N83-14202#** Brookhaven National Lab., Upton, N. Y.
**DESIGN AND PREPARATION OF NEW, HIGHLY ACTIVE FISCHER-TROPSCH CATALYSTS**
R. SAPIENZA, W. SLEGEIR, and T. OHARE 1981 24 p refs
Presented at 91st Natl Meeting of the AM. Inst. of Chem. Engr., Detroit, Mich., 16 Aug. 1981
(Contract DE-AC02-76CH-00016)
(DE82-003670; BNL-30289; CONF-810814-10) Avail: NTIS HC A02/MF A01

The application of the fundamental principles of the oxide mechanism of Fischer-Tropsch synthesis which emphasizes the relation between metal-oxygen bond strengths and catalyst activity, has resulted in a new series of highly active Fischer-Tropsch catalysts. These systems may point the way to future syngas catalyst development. The unique structural features of these catalysts have demonstrated the importance of surface structure and its relationship to catalyst composition and activity. DOE

**N83-14205#** Battelle Columbus Labs., Ohio.
**CAO INTERACTIONS IN THE STAGED COMBUSTION OF COAL Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981**
A. LEVY and E. L. MERRYMAN 1981 31 p refs
(Contract DE-AC22-80PC-30301)
(DE82-003273; DOE/PC/30301/4; QTPR-4) Avail: NTIS HC A03/MF A01

The reaction of sulfur-bearing compounds with CaO to form CaS, a kinetic and chemical parameters governing CaS and CaSO4 formation in staged combustion were investigated The reaction of pyrite with CaO in the absence of oxygen produced CaS in increasing amounts as the temperature was raised to at least 1100 C, reaching a maximum 50 percent conversion at 1100 C after several second reaction time. The rate of CaS formation decreased significantly with time at this temperature. An unidentified compound also formed at the higher temperatures and longer reaction times which appeared to contain significant amounts of calcium and iron. At short reaction times, much of the sulfur appeared to be tied up as pyrrhotites and unreacted FeS2 with some CaS and possibly CaSO4 present. The reaction of H2S and COS with CaO is rather slow in the absence of oxygen. The formation of CaS from combustion of pulverized coal in a methane flame was investigated. DOE

**N83-14206#** Oak Ridge National Lab., Tenn.
**CHEMICALS ENHANCED OIL RECOVERY Semiannual Report, 1 Apr. - 30 Sep. 1980**
A. L. COMPERE, J. M. CRENSHAW, S. V. GREENE, W L. GRIFFITH, J. S. JOHNSON, JR., R. M. JONES, L. J. MAGID, R. TRIOLO, and C. G. WESTMORELAND Nov. 1981 41 p refs
(Contract W-7405-ENG-26)
(DE82-003475; DOE-BETC-OR-18) Avail: NTIS HC A03/MF A01

Progress reports are presented for the following research areas: phase behavior in multicomponent systems containing tall oil ethoxylates; anionic tall oil derivatives (materials and methods, phase studies, interfacial tensions); sacrifical agents; economic considerations in materials selection; and materials and methods. A survey on the availability of materials, which could be used for micellar flooding revealed that some of the alternative chemicals could substantially decrease micellar flooding chemical costs. Production of C3 and C4 alcohols and vegetable and tall oil fatty acids appear at a high enough level so that their use to produce one million bbl of incremental oil per day would consume a substantial but not prohibitive fraction. DOE

**N83-14207#** Air Products and Chemicals, Inc., Allentown, Pa
**CATALYST AND REACTOR DEVELOPMENT FOR A LIQUID-PHASE FISCHER-TROPSCH PROCESS Quarterly Technical Progress Report, 1 Jul. - 30 Sep. 1981**
P. N. DYER, R. PIERANTOZZI, B. W. BRIAN, and J. V. BAUER Oct. 1981 38 p refs
(Contract DE-AC22-80PC-30021)
(DE82-003369; DOE/PC-30021/T7) Avail. NTIS HC A03/MF A01

Progress in investigations carried out in Task 2, slurry catalyst development, and in Task 3, slurry reactor design studies is reported. In Task 2, the 300 mL and 1000 mL slurry reactors ordered were constructed and instrumented. Mass transfer tests in the No. 1 300 mL slurry reactor were incorporated into the baseline catalyst test, because of the low activity that was found in two tests of a ruthenium methanation catalyst in the slurry phase. Two modified conventional catalysts were prepared and five gas phase screening tests were carried out, giving additional information on the conditions required to produce an enhanced C10(+) fraction. Eight supported cluster catalysts were synthesized, and eleven were screened in the gas phase In Task 3, measurements of gas holdup and solids dispersion were completed for the silica/isoparaffin system. Preliminary correlations were derived for gas holdup as a function of gas velocity and slurry density; a near zero-order dependence upon slurry velocity was observed. The column solids profile was constant for the conditions studied. Bubble diameters were measured photographically in the two-phase system. DOE

**N83-14208#** Bituminous Coal Research, Inc., Monroeville, Pa.
**PETROGRAPHIC EVALUATION OF PYRITE IN THE PRODUCTS FROM TWO-STAGE COAL-PYRITE FLOTATION Final Report, 1 Apr. 1980 - Nov. 1981**
R. S. TOMICH and R. S. MOSES Nov 1981 46 p refs
(Contract DE-AC22-80PC-30134)
(DE82-003593; DOE/PC-30134-1) Avail: NTIS HC A03/MF A01

The extent of pyritic sulfur reduction by the two-stage coal-pyrite flotation process can be predicted from the results of petrographic analyses conducted on the raw coal feed sample, Correlation studies show that the specific coal and pyrite characteristics that have a major influence on reduction of pyritic sulfur are: (1) coal rank; (2) the degree of pyrite liberation; (3) amount of pyrite available (pyritic sulfur, percent of total sulfur); and (4) pyrite-size distribution (especially the percentage of pyrite particles less than 32-micron size). The results of chemical analysis may be used to monitor a coal's response to the two-stage coal-pyrite flotation process; however, petrographic analysis is essential to precisely define the coal and pyrite characteristics that influence this response. DOE

**N83-14291#** Federal Aviation Administration, Washington, D.C
**THE IMPACT OF PETROLEUM, SYNTHETIC AND CRYOGENIC FUELS ON CIVIL AVIATION Final Report**
C. L BLAKE Jun. 1982 210 p
(FAA-EM-82-29) Avail: NTIS HC A10/MF A01

Various concerns with regard to aviation fuels are discussed, including price, the effects of supply and demand, the various sources and forms of supply, alternatives, and conservation measures which reduce demand The likelihood, the nature, and the effects of disruption in foreign crude oil deliveries to the United States are discussed. R.J.F.

**N83-14293*#** Chem Systems, Inc., New York.
**TECHNICAL AND ECONOMIC ASSESSMENT OF PROCESSES FOR THE PRODUCTION OF BUTANOL AND ACETONE Final Report**
Sep 1982 77 p refs Prepared for JPL
(Contract NAS7-100; JPL-956277)
(NASA-CR-169623; NAS 1.26:169623) Avail: NTIS HC A05/MF A01 CSCL 21D

This report represents a preliminary technical and economic evaluation of a process which produces mixed solvents (butaol/acetone/ethanol) via fermentation of sugars derived from renewable biomass resources. The objective is to assess the technology of producing butanol/acetone from biomass, and select a viable process capable of serving as a base case model for technical and economic analysis. It is anticipated that the base case process developed herein can then be used as the basis for subsequent studies concerning biomass conversion processes capable of producing a wide range of chemicals. The general criteria utilized in determining the design basis for the process are profit potential and non-renewable energy displacement potential The feedstock chosen, aspen wood, was selected from a number of potential renewable biomass resources as the most readily available in the United States and for its relatively large potential for producing reducing sugars. Author

**N83-14294#** Naval Research Lab., Washington, D. C.
**THE EFFECT OF ADDITIVES ON THE AEROSOLIZATION OF JP-5 JET FUEL Final Report**
R. C LITTLE, R. PRATT, and J. B. ROMANS 25 Aug 1982 33 p refs
(AD-A119324; NRL-MR-4694) Avail: NTIS HC A03/MF A01 CSCL 21D

The May spinning top aerosol generator was used to generate aerosols from neat Navy jet fuel and selected dispersions of three types of polymer additives in the jet fuel. The additives selected were Oppanol B-200, a Vistanex Series, and a proprietary antimisting additive designated as FM-9. The mass median diameter (MMD) of the droplets produced was studied as a function of additive concentration and spinning top velocity for each additive. In the case of each additive the MMD significantly increased with concentration at constant RPS. The effect of the Oppanol B-200 was comparable to that of FM-9 with respect to its influence on the MMD. GRA

**N83-14299#** Carnegie-Mellon Univ., Pittsburgh, Pa. Center for Energy and Environmental Studies
**PROGRAM OF BASIC RESEARCH ON THE UTILIZATION OF COAL-WATER MIXTURE FUELS Quarterly Report, period ending 30 Sep. 1981**
E. Z CASASSA, J. PADMANBAN, G. D. PARFITT, S. A. RAO, E. S. RUBIN, H. T SOMMER, and E. W. TOOR 1981 18 p refs
(Contract DE-FG22-81PC-40285)
(DE82-002232; DOE/PC-40285/T1) Avail: NTIS HC A02/MF A01

Two areas of special importance to the successful use of coal-water slurries are discussed: mixture stability and atomization. Activities in the study of mixture stability are reviewed. The atomization of coal-water slurries is discussed. DOE

**N83-14300#** United Technologies Research Center, East Hartford, Conn
**REACTION-INDUCED TEMPERATURE DEVIATIONS DURING COAL DEVOLATILIZATION IN A HEATED GRID**
J. D. FREIHAUT, M. F. ZABIELSKI, and D. J. SEERY 1981 10 p refs
(Contract DE-AC21-81MC-16221)
(DE82-003864; DOE/MC-16221/T5) Avail: NTIS HC A02/MF A01

The effects of sample characteristics on local heating of the grid were examined to assess the influence of devolatilization on programmed heating rates. The devolatilization process on the time temperature history of the local screen in immediate contact with the sample was determined. With respect to the coal particles, the direct implication is that the temperature path is the resultant of several components: the resistive heating of the grid, the physical properties of the samples, the devolatilization properties of the sample. Once the range of devolatilization temperatures of a particular coal is achieved, the primary devolatilization process appears to dominate the temperature-time trajectory In addition, the data appears to indicate that the heat requirement varies with the rank characteristics of the coal. The tar release is closely coupled in time to the devolatilization-induced temperature deviations during primary devolatilization and the onset of the tar release significantly precedes the slower light hydrocarbon gas evolution GRA

**N83-14301#** Pennsylvania State Univ., University Park. Dept. of Mineral Engineering.
**EXPANSION OF COAL-PREPARATION-PLANT SIMULATOR Progress Report, 1 Jul. - 30 Sep. 1981**
P T. LUCKIE and L. G. AUSTIN 1 Oct. 1981 19 p refs
(Contract DE-AC22-80PC-30144)
(DE82-001576; DOE/PC-30144/T5) Avail: NTIS HC A02/MF A01

Progress in the development and testing of modules for a centrifuge and a vacuum filter is reported. These modules have the following special characteristics: comminution and size degradation calculations for the centrifuge; loss of fines to the filtrate and centrate liquors and subsequent change in particle size distributions, calculation of equilibrium moisture content for the finished cake; and estimation of the final moisture content based on the equilibrium moisture content and the time the coal particles are exposed to the desaturating forces. The modules were incorporated into the main simulation program and tested using three typical feeds for coal preparation plants. Results were good with the exception of the calculation of the equilibrium moisture content. The final summary reports were expanded to include overall flow rates of clean coal, middling and refuse leaving the plant, overall yield data; and overall economic (cost) data. The economic calculations require a knowledge of the hourly tonnage of raw coal entering the plant, the number of hours of operation per week, and an overall annualized cost. DOE

**N83-14306#** Naval Postgraduate School, Monterey, Calif.
**THE USE OF BUOYANCY TO LIFT HEAVY OBJECTS FROM THE SEA M.S. Thesis - MIT**
R. P. FISKE Jun. 1981 138 p refs
(AD-A119320) Avail: NTIS HC A07/MF A01 CSCL 13J

To recover oil from economically marginal offshore fields the re-use of production platforms has been considered. Re-use involves severing the jacket from the seabed, rotating the jacket to the horizontal and lifting it through the air/sea interface in a configuration suitable for towing. Five systems are considered for use in the recovery process. Two systems currently used for installation are found suitable for modification to recover jackets. They are the pontoon barge system and the self-floating tower. Major problems to be overcome in modifying for retraction are mating of the pontoon barge with the tower, developing a pile system which can be refurbished, and ensuring transverse stability on retraction through the air/sea interface. GRA

**N83-14454#** Los Alamos Scientific Lab., N. Mex.
**NUMERICAL SIMULATION OF FLUID FLOW IN POROUS/FRACTURED MEDIA**
B. J. TRAVIS and T. L. COOK 1981 8 p refs Presented at the 5th Uranium Seminar, Albuquerque, N. Mex., 20-23 Sep. 1981
(Contract W-7405-ENG-36)
(DE82-002631; LA-UR-81-3256; CONF-810949-2) Avail: NTIS HC A02/MF A01

Theoretical models of fluid flow in porous/fractured media can help in the design of in situ fossil energy and mineral extraction technologies. Because of the complexity of these processes, numerical solutions are usually required. Sample calculations illustrate the capabilities of present day computer models. DOE

**N83-14495#** National Center for Resource Recovery, Washington, D. C.
**INVESTIGATION OF ENGINEERING AND DESIGN CONSIDERATIONS IN SELECTING CONVEYORS FOR DENSIFIED REFUSE-DERIVED FUEL (DRDF) AND DRDF: COAL MIXTURES Final Report, Jun. 1980 - Sep. 1981**
Z. KAHN, M. L. RENARD, and J. CAMPBELL Tyndall AFB, Fla AFESC Aug. 1981 129 p refs
(Contract MIPR-N-80-33; EPA-R-806709; AF PROJ. 2054)
(AD-A119065; AFESC/ESL-TR-81-58) Avail: NTIS HC A07/MF A01 CSCL 13C

An engineering evaluation and experimental program involving several types of conveyors applied to blends of densified refuse-derived fuel (dRDF) and blends of dRDF and coal, was conducted by the National Center for Resource Recovery. The final project report discusses the properties of waste affecting convey ability and presents experimentally determined values or observed characteristics A procedure was selected for the assessment, selection, and operation of belt conveyors based on spillage rate. Corroborating experimental results from a recirculating test rig operated with samples of dRDF and a blend of dRDF and coal over a range of belt configurations, velocities and flow rates were also presented. Experiments conducted on a vibrating pan conveyor over a range of frequencies and stroke length, and on a small apron conveyor, were described and the test results analyzed. Author (GRA)

**N83-14607*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**LONGWALL SHEARER TRACKING SYSTEM Patent Application**
P. D. POULSEN (Adjunct Systems, Inc), R. J. STEIN, and R. E. PEASE, inventors (to NASA) 15 Nov. 1982 20 p
(Contract NAS8-34185)
(NASA-CASE-MFS-25717-1; US-PATENT-APPL-SN-441897)
Avail: NTIS HC A02/MF A01 CSCL 08I

A tracking system for measuring and recording the movements of a longwall shearer vehicle includes an optical tracking assembly carried at one end of a desired vehicle path and a retroreflector assembly carried by the vehicle. Continuous horizontal and vertical light beams are alternately transmitted by means of a rotating Dove prism to the reflector assembly. A vertically reciprocating reflector interrupts the continuous light beams and converts these to discrete horizontal and vertical light beam images transmitted at spaced intervals along the path. A second rotating Dove prism rotates the vertical images to convert them to a second series of horizontal images while the first mentioned horizontal images are left unrotated and horizontal NASA

**N83-14628#** Electromagnetic Systems Labs., Inc., Sunnyvale, Calif. Imagery Data Systems.
**REMOTE SENSING APPLICATIONS TO THE DEVELOPMENT OF AN INTEGRATED DATA BASE FOR OIL AND GAS EXPLORATION**
R. J. HALL *In* ESA Satellite Remote Sensing for Developing Countries p 171-174 Jun. 1982 refs
Avail: NTIS HC A11/MF A01

Techniques employed in oil and gas exploration and the utility of satellite data to the exploration process are discussed. The application of satellite information to geologic analysis, planimetric mapping and other data collection efforts associated with the search for oil and gas are considered. Geographic information and image processing features that were utilized in three projects are outlined and the potential of data sources such as LANDSAT-D is assessed. Experience shows that satellite imagery is of greatest benefit when it is integrated into a comprehensive data base with conventional data. Author (ESA)

**N83-14658#** California Univ., Riverside. Inst. of Geophysics and Planetary Physics.
**AN INTEGRATED MODEL FOR THE NATURAL FLOW REGIME IN THE CERRO PRIETO HYDROTHERMAL SYSTEM, B.C., MEXICO, BASED UPON PETROLOGICAL AND ISOTOPE GEOCHEMICAL CRITERIA**
W. A. ELDERS, A. E. WILLIAMS, and J. R. HOAGLAND 1981 7 p refs Presented at the 3rd Symp. on the Cerro Prieto Geothermal Field in Baja California, Mexico, San Francisco, Mar. 1981
(Contract DE-AT03-80SF-11458)
(DE82-001980; CONF-810399-3) Avail: NTIS HC A02/MF A01

Studies of cuttings and core at Cerro Prieto have now been extended to more than 50 boreholes. The aims of this petrological and isotopic work are to determine the shape of the reservoir, its physical properties, and its temperature distribution and flow regime before the steam field was produced. A map showing the first occurrence of hydrothermal epidote shows a dome shaped top to the steam producing zone. The hottest of the mapped mineral zones - the biotite vermiculite zone - shows a dome displaced to the northeast relative to the epidote zone. Patterns of mineral zones observed in wells are consistent with patterns of oxygen isotopic ratios in calcite and quartz. Using both criteria all of the boreholes so far studied were classified as belonging to one of four different regimes. DOE

**N83-14661#** California Univ., Riverside Inst. of Geophysics and Planetary Physics.
**USE OF WIRELINE LOGS AT CERRO PRIETO IN IDENTIFICATION OF THE DISTRIBUTION OF HYDROTHERMALLY ALTERED ZONES AND DIKE LOCATIONS AND THEIR CORRELATION WITH RESERVOIR TEMPERATURES**
D. T. SEAMOUNT, JR. and W. A. ELDERS 1981 6 p refs Presented at the 3rd Symp on the Cerro Prieto Geothermal Field in Baja California, Mexico, San Francisco, Mar. 1981
(Contract DE-AT03-80SF-11458)
(DE82-001981, CONF-810399-5) Avail: NTIS HC A02/MF A01

Downhole electrical and gamma-gamma density logs from nine wells were studied and the wireline log parameters with petrologic, temperature, and petrophysical data were correlated. Wells M-43, T-366, and M-107 are discussed as typical cases. Log data for shales show good correlation with four zones of hydrothermal alteration previously recognized on the basis of characteristic mineral assemblages and temperatures. GRA

**N83-14750#** Los Alamos Scientific Lab., N. Mex.
**POWER FROM THE HOT-DRY-ROCK GEOTHERMAL RESOURCE**
N. M. BECKER, R. A. PETTITT, and R. H. HENDRON 1981 30 p refs Presented at ASME/IEEE Joint Power Generation Conf., St. Louis, 4 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-000759; LA-UR-81-2842; CONF-811008-3) Avail: NTIS HC A03/MF A01

The history of the development of the first hot dry rock (HDR) reservoir is presented. Particulars on the surface piping and data collection system are described. It is found that the geothermal reservoir growth is due in large part to pressurization and thermophysical effects. The impedance to flow along the fractures within the reservoir decreases as thermal contraction and pressurization of the reservoir continue to open natural joints. Minimal environmental effects were noted as a result of closed system circulation; and the chemical quality of the geothermal

fluid is good, in contrast to the corrosive geothermal fluids in many hydrothermal systems. It is found that an HDR system is operational, and is used to answer questions raised by the theoretical research The types and options of power generation available are addressed. A binary fluid cycle that can use nonaqueous working fluids is an alternative to single or multiple flash systems. These nonaqueous fluids may fall within a large range of hydrocarbon, fluorocarbon, and organic fluids. The R-114 was tested in binary cycle at Fenton Hill and was chosen largely for its heat transfer characteristics and previous industrial experience GRA

**N83-14752#** California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
**CATALYTIC LIQUEFACTION OF BIOMASS**
H. DAVIS, C. FIGUEROA, C. KARATAS, D. KLODEN, L. SCHALEGER, and N. YAGHOUBZADEH Oct. 1981 29 p refs Presented at the 13th Biomass Thermochem. Conversion Contractors Meeting, Washington, D C , 27-29 Oct. 1981
(Contract W-7405-ENG-48)
(DE82-003329; LBL-13449; CONF-8110115-1) Avail: NTIS HC A03/MF A01

The bench scale continuous liquefaction unit (CLU) in operation as a back mixed reactor. It is used to explore a factional experiment in temperature, time, slurry pH, gas to slurry feed ratio and other variables. It is available for a wide range of biomass or even fossil feedstocks. New methods of characterizing oil and water soluble products were developed and applied to CLU products. Conditions under which formate ion, probable intermediate in both water gas shift reaction and reduction of biomass oxygen by CO, is formed in large quantities are found. Raw wood chips undergo solvolysis, total dissolution, when mixed with wood liquefaction oil and heated under certain conditions. This phenomenon must occur to some degree in the initial stages of the PERC process. It is suggested that solvolysis is a possible way to get the benefits of oil recycle. Without the uneconomically high recycle ratios of the PERC process. GRA

**N83-14775#** Pennsylvania State Univ., University Park Dept. of Chemistry.
**DEVELOPMENT OF INSTRUMENTAL METHODS OF ANALYSIS OF SULFUR COMPOUNDS IN COAL PROCESS STREAMS Final Technical Report, 30 Sept. 1977 - 29 Sep. 1981**
J. JORDAN 1981 12 p refs
(Contract DE-AC22-77ET-10482)
(DE82-003253; DOE/ET-10482/T4) Avail: NTIS HC A02/MF A01

The general objective was resource development in the analytical chemistry of sulfur compounds for the evolving new coal technologies. Based on fundamental considerations, judiciously selected methods of instrumental analysis were developed for determining sulfur compounds in coal conversion process streams. Significant sulfur moieties were identified with the aid of thermodynamic criteria, taking into account the blocking of some equilibria by sluggish kinetics Two discrete types of procedures were developed for selected moieties, viz., (1) enthalpimetric methods, which rely on measurements of heats of reaction in adiabatic cells; (2) voltammetric methods, using glassy carbon indicator electrodes. Stability domains of thirty-six (36) inorganic sulfur compounds were mapped as functions of redox potential and pH. Based on this information, the occurrence probability of specified sulfur contaminants in coal conversion streams was assessed. DOE

**N83-14795#** Global Geochemistry Corp., Canoga Park, Calif.
**GEOCHEMICAL STUDIES OF CORES FROM THE SAN JUAN BASIN RESEARCH SITE, GRANTS URANIUM REGION, NEW MEXICO Final Report**
R HADDAD, I. KAPLAN, D. CARLISLE, K. DELANCEY (California Univ., Irvine), and V. P. GUINN (California Univ., Irvine) Sep. 1981 255 p refs
(Contract DE-AC13-76GJ-01664)
(DE82-004153; GJBX-312-81) Avail: NTIS HC A12/MF A01

A geochemical study performed in the southern part of the Grants Uranium Region is described. Five hundred samples were analyzed for a suite of 23 trace and minor elements. One hundred samples were analyzed for (13)C/(12)C and (18)O/(16)O on carbonates, (13)C/(12)C on organic matter, (34)S/(32)S on sulfur, total sulfur and total organic and inorganic carbon. A detailed study was performed on carbonaceous material by separating the kerogen and extracting the bituminous material From the study, it was inferred that the deposit is a modified primary or trend deposit altered by solutions. The evidence is based upon the following parameters: (1) there is no correlation between the carbon and uranium contents and the content of carbonaceous material is generally uniform between 0 05 to 0.10%; (2) sulfur isotope ratios of pyrite associated with uranium mineralization from a bimodal distribution. DOE

**N83-14816** Virginia Univ., Charlottesville.
**WIND POWER ASSESSMENT ALONG THE ATLANTIC AND GULF COASTS OF THE UNITED STATES Ph.D. Thesis**
J. W. SNOW 1981 260 p
Avail: Univ. Microfilms Order No. DA8219076

A methodology is developed for producing detailed wind power surveys. It is applied in areas of the U.S. Atlantic and Gulf coastal zones. The initial steps in estimating the amount and areal distribution of wind power are climatological. A numerical model of the atmosphere which treats explicitly the physical processes occuring with the boundary layer is conditioned to represent the geophysical aspects of the designated area. Five wind regimes are identified, using essentially the classical mid-latitude cyclone concept, and, by region, the length of each wind season is determined along with the composition of each season in terms of the frequency of occurrence of each regime. The three season-regime situations occuring most frequently are identified and typical cases of each are selected from meterological records. Dissert. Abstr.

**N83-14877#** National Academy of Sciences - National Research Council, Washington, D. C. Committee on Arctic Seafloor Engineering.
**UNDERSTANDING THE ARCTIC SEA FLOOR FOR ENGINEERING PURPOSES**
1982 141 p refs
(Contract N00014-80-G-0034)
(AD-A119773) Avail: NTIS HC A07/MF A01 CSCL 08J

This report identifies and assesses those arctic seafloor phenomena that influence the design and operation of facilities and platforms for exploring and producing oil, gas, and hard minerals both on and under the sea floor. It also identifies knowledge that is needed of seafloor phenomena and conditions, and, for several areas of major concern, recommends specific research. These recommendations are intended to enhance the ability of the engineer and operator to anticipate and avoid problems that may be posed by seafloor and coastal phenomena, and guard against the effects of such events as thaw subsidence and erosion. Permafrost, often thought to be found only on land, is found extensively beneath the sea floor of the Beaufort Sea, and, to an extent not well known, under the Chukchi and Bering seas. A relict of the geological past, it was covered by rising artic oceans. Permafrost can deteriorate because of natural or man-induced effects and can reform again. GRA

**N83-15322#** Atomic Energy Research Establishment, Harwell (England). Computer Science and Systems Div.
**AN EFFICIENT FULLY IMPLICIT SIMULATOR**
B. A. FOSTER, P. F. NACCACHE, M. O. NICHOLAS, R. K. POLLARD, D. K. PONTING, J. RAE, D. BANKS (British National Oil Corp., Glasgow), and S. K. WALSH (AEE Winfrith) May 1982 39 p refs
(CSS-126) Avail: NTIS HC A03/MF A01

An efficient general purpose black oil simulator, PORES, now in production use for modelling North Sea fields is described. The fully implicit finite difference equations are solved for each time step using a Newton-Raphson procedure. The resulting large sets of linear equations are usually solved simulataneously by a powerful iterative method which uses a preconditioned conjugate gradient algorithm with an enforced column sum condition to accelerate convergence. A sequential solution option is available and direct matrix inversion methods are also provided. Gas condensate problems are handled by a variable switching technique. Four examples are presented to illustrate the power and efficiency of the program. S.L.

**N83-15395#** Sandia Labs., Albuquerque, N Mex
**EFFECTS OF SOLVENT COMPOSITION AND CONCENTRATION ON EARLY LIQUEFACTION REACTIONS**
M G. THOMAS 1981 16 p Presented at the H-Coal Tech. Advisory Comm. Meeting, Catlettsburg, Ky., 15 Sep. 1981
(Contract DE-AC04-76DP-00789)
(DE82-004136; SAND-81-2000C; CONF-810999-1) Avail: NTIS HC A02/MF A01

The early reaction chemistry of coal liquefaction includes the dissolution of coal by reaction with solvent to produce preasphaltenes. The subsequent decomposition to asphaltenes and finally to oils can be described with a classic series reaction mechanism. Neither dissolution nor upgrading rates are independent of solvent. In terms of solvent, dissolution appears to be stoichiometric with preasphaltene formation, and secondary reaction rates are dependent upon hydrogen availability. Some of the ramifications of these early reactions are: multistage processing; effective utilization of catalysts; tailored product slate; and hydrogen utilization. DOE

**N83-15402#** Avco-Everett Research Lab., Mass.
**VOLATILE PRODUCTION DURING PREIGNITION HEATING Quarterly Progress Report, Jul. - Sep. 1981**
Oct. 1981 21 p refs
(Contract DE-AC22-80PC-30291)
(DE82-003061, DOE/PC-30291-4) Avail: NTIS HC A02/MF A01

The relationship between volatile matter production from pulverized coal and flame stabilization in a boiler environment was examined. The entire flow, optics and diagnostic systems were installed in the test cell and are operational. Problems with beam quality for the CO2 laser were remedied by the design of a new beam splitting roof prism mirror. Coal is flowed in the presence of laser heating and the flow behaves qualitatively as expected. DOE

**N83-15427#** Oak Ridge National Lab., Tenn.
**CORROSION IN FRACTIONATION SYSTEMS**
R. A. BRADLEY, J. R. KEISER, R. R. JUDKINS, V. B. BAYLOR, and J. H. DEVAN 1981 12 p refs Presented at the 6th Ann. Conf. on Mater. for Coal Conversion and Util., Gaithersburg, Md., 13 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-001441; CONF-811061-3) Avail: NTIS HC A02/MF A01

All data collected to date suggest that chlorine, as water soluble chlorides, is necessary, albeit not sufficient, to cause the accelerated corrosion observed in pilot plant fractionation columns. Mechanisms for the transportation of chlorine to the fractionation columns, for the concentration of chlorine in these columns, and for the corrosion of the materials of construction of these columns are proposed. The source of the chlorine is the coal feed. When the coal is fed to the dissolver vessels, hydrogen chloride may be formed by volatilization or by hydrolysis of chloride salts followed by volatilization. These amine hydrochlorides are transported in liquid streams to the fractionation area. Washing the coal liquids with water to remove the water soluble chlorides and the addition of certain amines are proposed as methods for reducing the corrosion. DOE

**N83-15489#** Southwest Research Inst., San Antonio, Tex. Fuels and Lubricants Research Lab.
**ASSESSMENT/REVIEW OF METHANOL TECHNOLOGY AND UTILIZATION AS A FUEL Interim Report, Oct. 1981 - Sep. 1982**
G. H. LEE, L. L. STAVINOHA, and R. G. ZOSCHAK Jul. 1982 78 p refs
(Contract DAAK70-82-C-0001; DA PROJ. 1L7-62733-AH-20)
(AD-A120109; AFLRL-161; SWRI-6800-121) Avail: NTIS HC A05/MF A01 CSCL 07C

Alcohols, in particular methanol and ethanol, are currently being extensively studied for feasibility of use as neat fuels, fuel extenders, and/or octane improvers. This report provides a review of methanol technology and a preliminary assessment of its potential for use as a mobility/stationary equipment fuel. A high degree of technical feasibility has been indicated for both increased methanol production and use as a fuel, principally in burners, turbines, and spark ignition engines. Generally, the methanol fuel of choice for direct utilization is not neat methanol, but a methanol fuel containing materials such as isopentane or gasoline (up to 10 covo1%) to improve cold start, volatility, and other fuel properties. Modifications of existing equipment are generally needed for direct use of fuel grade methanol except in fuel cells. Use of methanol at low concentrations as an additive or gasoline extender presents fewer problems of system corrosion and elastomer compatibility. A program to demonstrate the potential for utilization of methanol (both direct and as an extender) in DOD equipment has been recommended. Under this program, the Army would evaluate the equipment performance in various climates, test the equipment reliability/durability, and resolve related support questions on the safe and efficient storage, distribution, and use of methanol fuel. GRA

**N83-15495#** National Fertilizer Development Center, Muscle Shoals, Ala.
**THE TENNESSEE VALLEY AUTHORITY'S BIOMASS FUELS PROGRAM**
J. M. STINSON 1981 21 p refs Presented at Interagency Workshop on Biomass, Washington, D.C., 14-15 May 1981
(DE81-904161; CIRC-Z-120; CONF-8105119) Avail: NTIS HC A02/MF A01

Information and processes that allow effective use of biomass (principally wood) by industry are investigated. Hardwoods are converted to ethanol by acid hydrolysis. An acid hydrolysis process which should decrease cost of production and improve process efficiency is studied. Direct combustion of wood in commercial and industrial furnace/boilers to replace oil and natural gas is feasible and is receiving considerable attention. Technical assistance is provided to encourage commercialization. Other activities include: (1) development of wood resource information and harvesting techniques; (2) determining productivity of nonwood biomass crops for ethanol production and potential land availability for biomass crops; (3) development of a farm scale fuel alcohol unit to utilize various nonwood feedstocks; and (4) marketing and distribution assessments. DOE

**N83-15496#** Los Alamos Scientific Lab., N Mex.
**ANALYSIS OF PREBURN THREE-DIMENSIONAL FLOW PATTERNS IN UNDERGROUND COAL CONVERSION**
B. J. TRAVIS and H. E. NUTTALL (New Mexico Univ., Albuquerque) 1981 9 p refs Presented at the 7th Underground Coal Conversion Symp., Fallen Leaf Lake, Calif., 8-11 Sep. 1981 Sponsored in part by the Public Service Co. and Western Coal Co.
(Contract W-7405-ENG-36)
(DE82-002405; LA-UR-81-2933; CONF-810923-12) Avail: NTIS HC A02/MF A01

A three dimensional numerical study was performed to better elucidate the rather complex flow patterns that can occur during the bed preparation stage of underground coal gasification when the linked vertical well method is applied. The important effects of the 3-D geometry, gravity, anisotropy, pressure dependent permeability, and dynamic two phase air/water flow are discussed. For the first time the dynamic, 3-D growth of the air bubble (i.e., the dewatered region) is studied under simulated field conditions for western subbituminous coal. Interpretation of the 3-D flow and tracer patterns is an important element in an effective site characterization program. The numerical code used in these studies WAFE3D, was developed to compute multiphase, multicomponent mass and heat transport in porous/fractured geological media. The code solves the time dependent 3-D conservation equations for mass, momentum, and energy using an integrated finite difference implicit numerical scheme. DOE

**N83-15497#** Battelle Columbus Labs., Ohio.
**POTENTIAL FOR USE OF PEAT BLENDS WITH COAL FOR ELECTRIC POWER GENERATION Final Technical Report, Apr. 1981**
D. ANSON, J. MURIN, and H. R. HAZARD 1981 115 p refs
(Contract DE-AC18-80FC-10231)
(DE82-003634; DOE/PC/10231-T1) Avail: NTIS HC A06/MF A01

The possible use of peat and coal blends in utility boilers was studied. From fuel and ash properties estimates were made of the changes from coal firing practice that would be required in boiler design and fuel preparation. Boiler fouling, slagging and efficiency effects were predicted and compared with behavior of plants operating on coal or peat alone. It is expected that blends containing 50 percent peat would require relatively minor design changes from coal firing practice, but the firing of peat calls for substantially different design approaches DOE

**N83-15498#** Los Alamos Scientific Lab., N. Mex.
**METHANE HYDRATE GAS PRODUCTION: EVALUATING AND EXPLOITING THE SOLID GAS RESOURCE**
P. L. MCGUIRE 1981 23 p refs Presented at the 4th Intern. Conf. on Alternative Energy Sources, Miami Beach, Fla., 14-16 Dec. 1981
(Contract W-7405-ENG-36)
(DE82-004373; LA-UR-81-3461, CONF-811212-3) Avail: NTIS HC A02/MF A01

Two methods of producing gas from hydrate deposits by the injection of hot water or steam are discussed. The feasibility of hydraulic fracturing and pressure reduction as a hydrate gas production technique is discussed A hydraulic fracturing technique suitable for hydrate reservoirs and a system for coring hydrate reservoirs are also described. DOE

**N83-15499#** Oak Ridge National Lab., Tenn Engineering Div.
**MODIFICATION OF FEED/EFFLUENT FLOW WORK EXCHANGERS FOR SLURRY SERVICE AND POWER RECOVERY IN COAL LIQUEFACTION PROCESSES**
J. R. HORTON 1981 17 p Presented at the Winter Ann. Meeting of the ASME Technol. and Soc. Div., Washington, 15-19 Nov. 1981
(Contract W-7405-ENG-26)
(DE82-004114; Y/EN-511; CONF-811101-15) Avail: NTIS HC A02/MF A01

Process and equipment modifications necessary for application of modified flow work exchangers in coal liquefaction processes are reviewed. A discussion is provided on flow work exchanger-like devices such as the Pipefeeder and the Hydro-hoist. The benefits in minimizing the use of or elimination of critical and problem equipment in conventional coal liquefaction plants such as pressure letdown valves and large high head slurry pumps are compared with the most critical problems with slurry feed/effluent flow work exchangers. Performance of disc type slurry valves which are being considered for flow work exchangers in slurry service is discussed. A preliminary assessment of the cost/benefits of power recovery in coal liquefaction utilizing feed/effluent work flow exchangers is discussed.

**N83-15628*#** IMA Resources, Washington, D.C.
**DESIGN AND FEASIBILITY STUDY FOR A PORTABLE OIL RECOVERY TURBOPUMP Final Report**
30 May 1982 65 p refs
(Contract NAS8-34538)
(NASA-CR-170704; NAS 1.26:170704) Avail: NTIS HC A04/MF A01 CSCL 13K

A portable oil recovery turbopump concept, using the Firefly module as primer mover, for the offloading of distressed tank vessels is examined. The demands to be met both in terms of the type of petroleum to be offloaded, as well as the operational requirements placed on the pump, are studied with respect to the capability of different pump configurations. Two configurations, one a centrifugal type and the other a screw type pump, are developed and evaluated. While the centrifugal configuration is found to be effective in a large proportion of tank vessel offloading situations, the screw type will be required where high viscosity cargoes are involved. The feasibility of the turbopump concept, with the Firefly module as prime mover, is established. Author

**N83-15712#** Tokyo Gas Co. Ltd. (Japan). Production and Engineering Dept.
**THERMAL ANALYSIS OF THE POSITION OF THE FREEZING FRONT AROUND AN LNG IN-GROUND STORAGE TANK WITH A HEAT BARRIER**
O. WATANABE and M. TANAKA (Kajima Inst. of Construction Technology) *In* CRREL Proc. of the 3d Intern. Symp. on Ground Freezing p 3-10 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 08M

A technique of controlling the extent of the freezing zone created by in ground liquefied natural gas storage tanks by installing a heat barrier is described. The freezing conditions around three representative tanks after operating the system were compared. M.G.

**N83-15732#** Huainan Mining Coll. (China).
**STUDY OF THE FREEZING PRESSURE ACTING ON A SHAFT LINING**
C. WANXI *In* CRREL Proc. of the 3d Intern Symp on Ground Freezing p 355-366 1982 refs
Avail: NTIS HC A20/MF A01 CSCL 20K

The carboniferous layer in Panji coal mining district is almost completely covered by water bearing overburdens of varying thickness. The total thickness of soil overburdens is more than 200 m. For the sinking of shafts through this overburden the freezing method is employed. The reinforced concrete lining has been applied in Panji shafts. It is found that freezing pressure augments with the increase of depth of the soil, the distribution of which being uneven. The freezing pressure resulting from the

deformation of the freezing wall is likely to give rise to the breaking of the reinforced concrete lining. Author

**N83-15801#** Sandia Labs., Albuquerque, N. Mex.
**MATERIAL PROPERTIES OF GREEN RIVER OIL SHALE**
L. S. COSTIN Oct. 1981 40 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003271; SAND-81-1457) Avail: NTIS HC A03/MF A01

A compilation of material property data on Green River (Piceance Basin) oil shale is presented. It is intended to provide a baseline of data to support various thermomechanical modeling efforts in progress. The data, presented in tabular form, are divided into three categories: elastic properties, failure properties and thermal properties. Within each category, the data are listed by kerogen content and test condition (confining pressure, temperature, etc.). Summaries of some of the important features of the elastic and failure properties of oil shale are presented in graphical form. DOE

**N83-15802#** Mound Lab., Miamisburg, Ohio.
**PHYSICAL AND CHEMICAL CHARACTERIZATION OF DEVONIAN GAS SHALE Quarterly Status Report, 1 Apr. - 30 Jun. 1981**
R. E. ZIELINSKI and E. STACY 1981 51 p
(Contract DE-AC04-76DP-00053)
(DE82-002560; MLM-MU-81-66-0012; MLM-EGSP-TPR-Q-018)
Avail: NTIS HC A04/MF A01

Organic carbon contents were determined for samples from the OH-9 and NY-5 wells. The average total organic content for each well was 2.51 wt %, respectively. Visual kerogen assessments were also completed for the OH-9 and NY-5 wells. The average values for the total hydrocarbon yield, volatile hydrocarbon content, and Peak II maximum temperature were 0 94 wt %, 1688 ppM, and 459 deg C for OH-9. The samples from NY-5 averaged 0.22 wt % hydrocarbon, with approximately 77% of the total derived from Peak II production. The average vitrinite reflectance values for each well were 0.44 and 1.28, respectively suggesting an immature shale in OH-9 and a mature shale in NY-5. The bulk samples were predominately clay (42 to 45%), pyrite (12 to 26%), and quartz (28 to 36%) for OH-9, while the NY-5 samples contained clay (31 to 40%), pyrite (11 to 32%), and quartz (19 to 29%). DOE

**N83-15803#** Department of Energy, Bartlesville, Okla. Energy Technology Center.
**CONTRACTS FOR FIELD PROJECTS AND SUPPORTING RESEARCH ON ENHANCED OIL RECOVERY AND IMPROVED DRILLING TECHNOLOGY Progress Review for quarter ending 30 Jun. 1981**
B. LINVILLE, ed. Sep 1981 142 p refs
(DE82-002598; DOE/BETC-81/3; PR-27) Avail: NTIS HC A07/MF A01

Reports are presented of contracts for field projects and supporting research on chemical flooding, carbon dioxide injection, thermal/heavy oil, as well as for the following areas of research: resource assessment technology; extraction technology; environmental; microbial enhanced oil recovery; improved drilling technology; and general supporting research. DOE

**N83-15805*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CATALYTIC COMBUSTION WITH STEAM INJECTION**
D. N. ANDERSON and R. R. TACINA 1982 15 p refs
Presented at the Joint Power Generation Conf., Denver, 17-21 Oct. 1982; sponsored by ASME
(NASA-TM-82923; E-1315; NAS 1.15:82923) Avail: NTIS HC A02/MF A01 CSCL 10B

The effects of steam injection on (1) catalytic combustion performance, and (2) the tendency of residual fuel to burn in the premixing duct upstream of the catalytic reactor were determined. A petroleum residual, no. 2 diesel, and a blend of middle and heavy distillate coal derived fuels were tested. Fuel and steam were injected together into the preheated airflow entering a 12 cm diameter catalytic combustion test section. The inlet air velocity and pressure were constant at 10 m/s and 600 kPa, respectively. Steam flow rates were varied from 24 percent to 52 percent of the air flow rate. The resulting steam air mixture temperatures varied from 630 to 740 K. Combustion temperatures were in the range of 1200 to 1400 K. The steam had little effect on combustion efficiency or emissions. It was concluded that the steam acts as a diluent which has no adverse effect on catalytic combustion performance for no. 2 diesel and coal derived liquid fuels. Tests with the residual fuel showed that upstream burning could be eliminated with steam injection rates greater than 30 percent of the air flow rate, but inlet mixture temperatures were too low to permit stable catalytic combustion of this fuel S.L.

**N83-15910#** Pacific Northwest Lab., Richland, Wash.
**THE WIND CHARACTERISTICS PROGRAM**
L. L. WENDELL *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 27-38 1981 refs
(Contract DE-AC06-76RL-01830)
Avail: NTIS HC A23/MF A01

Wind characteristics research activities emphasize wind resource assessment, site selection and evaluation techniques, and wind characteristics for wind turbine design, performance and operations evaluation. Wind resource analysis shows the greatest area of high wind power resource is in the midsection of the U.S High wind power is available in other sections of the country and is described in some detail on a state by state basis in twelve regional atlases. To carry the wind prospecting process to a finer scale, site selection techniques for small and large wind turbines were developed, tested, and documented. There is a broad range of sophistication and reliability in these techniques and their application must be matched with the priorities and time available for energy planning efforts. The nature of wind gustiness was evaluated statistically and modeled for calculating fatigue cycles and extreme events S L.

**N83-15923#** West Texas State Univ., Canyon. Alternative Energy Inst.
**AGRICULTURAL APPLICATION OF SWECS**
V. NELSON *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 227-236 1981 refs
Avail: NTIS HC A23/MF A01

Principal applications of wind energy for agriculture are (1) farmstead power, mainly electrical, (2) building heating, (3) irrigation pumping, (4) product storage and processing, (5) hot water for residences and dairies, and (6) associated industries of agribusiness such as feedlots, fertilizer elevators, greenhouses, etc. Field experiments show that wind energy is a viable alternative, however, reliability and maintenance are still major problems. Test results of the various experiments are described. S.L.

**N83-15951#** Sandia Labs , Albuquerque, N. Mex.
**OIL-SHALE PROGRAM Quarterly Report, Apr. - Jun. 1981**
B. E. BADER, ed. Oct. 1981 54 p refs
(Contract DE-AC04-76DP-00789)
(DE82-900588; SAND-81-1973; QR-22) Avail: NTIS HC A04/MF A01

The principal activities of the Sandia National Laboratories in the Department of Energy Oil shale program during the period April 1 to June 30, 1981 are discussed. Currently, Sandia's activities are focused upon: the development and use of analytical and experimental modeling techniques to describe and predict the retort properties and retorting process parameters that are important to the preparation, operation, and stability of in situ retorts, and the development, deployment, and field use of instrumentation, data acquisition, and process monitoring systems to characterize and evaluate in site up shale oil recovery operations. In-house activities and field activities (at the Geokinetics Oil Shale Project and the Occidental Oil Shale Project) are described under the headings: bed preparation, bed characterization, retorting process, and structural stability. DOE

**N83-15952#** California Univ., Livermore. Lawrence Livermore Lab.
**REACTION KINETICS AND DIAGNOSTICS FOR OIL-SHALE RETORTING**
A. K. BURNHAM 19 Oct. 1981 32 p refs Presented at 2nd IGT Symp. on Synthetic Fuels from Oil Shale, Nashville, 26 Oct. 1981
(Contract W-7405-ENG-48)
(DE82-001598; UCRL-86794; CONF-811054-1) Avail: NTIS HC A03/MF A01

The advances in pyrolysis chemistry and kinetics and the resulting diagnostic methods based on effluent products for determining retort performance were reviewed. Kerogen pyrolysis kinetics and stoichiometry were generalized by further measurements on a larger number of samples. Analysis by capillary column gas chromatography of shale oil samples produced under a variety of field and laboratory conditions resulted in a method for determining the oil yield from a combustion retort. Measurement of sulfur products under a variety of conditions led to an understanding sulfur reactions both those of processing and environmental importance. Equations for estimating the heat of combustion of spent shale were developed by understanding oil shale composition and reactions. GRA

**N83-15959#** Atomic Energy Research Establishment, Harwell (England).
**CORROSION TESTS IN THE MARCHWOOD GEOTHERMAL BOREHOLE**
P. F. LAWRENCE Mar. 1982 23 p
(AERE-G-2225) Avail: NTIS HC A02/MF A01

Corrosion tests in the high salinity brine produced during a production test at the Marchwood borehole. These tests were intended to obtain preliminary information on the corrosion of a range of metals and alloys most likely to be used for downhole service, heat exchangers and associated equipment, if hot water from this aquifer is used to provide a long-term energy source. Specimens of appropriate candidate materials were exposed to flowing brine in the surface pipework and also downhole at a depth of 663 m. The brine was pumped to the surface by a multi-stage electric submersible pump. The downhole specimens, which were installed with the pump, were exposed for a period of 83 days. The surface specimens were exposed during the well production test for 33.3 days. The product brine was around three times sea water concentration, at a temperature of 72 C and pH 6.2. Author

**N83-15965#** Geological Survey, Washington, D. C.
**THE GEOTHERMAL RESEARCH PROGRAM OF THE US GEOLOGICAL SURVEY**
1982 18 p refs
(USGS-CIRC-862) Avail: NTIS HC A02/MF A01

The history of the geothermal research program of the U.S. geological survey is presented. N.W.

**N83-16212#** Geo-Centers, Inc., Newton, Mass.
**EVALUATION OF PLASMA JET IGNITION FOR IMPROVED PERFORMANCE OF ALTERNATE FUELS Final Report, Feb. - Aug. 1982**
J. F. GRANT, Z. GOLENKO, and M. E. MCILWAIN Aug. 1982 87 p refs
(Contract DAAK70-82-C-0047; DA PROJ. 1L1-62733-AH-20)
(AD-A120160; GC-TR-82-256) Avail: NTIS HC A05/MF A01
CSCL 21B

Alcohols, such as ethanol and methanol, are potential substitutes for gasolines during periods of fuel shortages. The pure alcohols have been reported to cause performance and starting problems when used to fuel internal combustion engines. This study characterized how three modes of ignition, OEM magneto, high energy conventional spark (CI) and plasma jet ignition (PJI) influenced the engine combustion properties of ethanol, methanol and gasoline alcohol blends. Specific combustion properties examined in these measurement were burning velocity and lean limit. In addition, the engine performance was determined for 30% alcohol gasoline containing blends. These engine performance measurements determined brake power, brake specific fuel consumption and brake emissions of carbon monoxide and hydrocarbons. The findings of this study suggest that high energy ignition systems, such as plasma jet ignition, will improve both fuel combustion properties and engine performance. GRA

# 05

# ENERGY CONVERSION

Includes thermomechanical, thermoelectric, geothermal, ocean thermal, and wind energy conversion. Also includes nuclear reacters, magnetohydrodynamic generators, and fuel cells.

**A83-10641**
**ON THE OPTIMIZATION OF MAGNETIC FIELD SOURCES IN ELECTROMECHANICAL ENERGY CONVERSION**
J.-M. BIEDINGER and M. KANT (Compiegne, Universite de Technologie, Compiegne, France) Journal of Applied Physics, vol. 53, Oct. 1982, p. 7061-7070. Research supported by the Delegation Generale a la Recherche Scientifique et Technique. refs

This paper describes a numerical approach for the optimization of magnetic field sources, current distribution, and permanent magnets. The developments, based on the finite element method, consider two-dimensional, unsaturated models. As the criteria of optimization, the parameters representing the relationship existing between two Hermitian matrixes are used. An application of this method, in the case of a single-sided, linear motor, permits a number of conclusions to be made concerning the shape of the windings and their power supply. This work may prove useful in the optimization of devices with nonconventional geometry and/or supplied by power electronics. (Author)

**A83-10654#**
**GENERALIZED CHARACTERISTICS AND APPLICABILITY OF VARIOUS PROBABILITY DISTRIBUTIONS FOR WIND ENERGY APPLICATIONS**
S. ESKINAZI and D. E. CRAMER (Syracuse University, Syracuse, NY) Journal of Energy, vol 6, Nov.-Dec. 1982, p. 384-391. refs

The work in this paper attempts to show the presence of certain important general behavior characteristics of hourly wind speed variations in the atmospheric surface layer, in spite of differences that exist in site roughness, seasons, and thermal stability at each of the 28 different sites considered. Four different types of probability density distributions are matched (fitted) to a combination of the first four moments calculated from the real-time data of each of the nearly 100 site-months processed in this work. A new definition of 'best fit' is proposed; and on this basis, comparisons and recommendations are made. (Author)

**A83-10656#**
**APPROACH TO NITINOL POWER PLANT COST ANALYSIS**
J. L. MCNICHOLS, JR. (McDonnell Douglas Astronautics Co., Engineering Div., Huntington Beach, CA), J. S. CORY (Cory Laboratories, Escondido, CA), and E. H. CURTIS (U.S. Bureau of Reclamation, Office of Science and Technology, Washington, DC) Journal of Energy, vol. 6, Nov.-Dec. 1982, p. 399-405. refs

The objective of this paper is to provide a method for cost evaluation of low grade thermal energy conversion by Nitinol power plants. To accomplish this objective Nitinol power plant costs are subdivided into those which can be obtained through conventional cost analysis, and those which are associated with the Nitinol heat engine and are not subject to conventional analysis. Analytic expressions are provided for the Nitinol heat engine capital costs and Nitinol replacement costs in terms of Nitinol performance, heat engine configuration, plant operating factors, material costs, and the cost of capital. Nitinol working material factors are identified

that require further definition before firm and reliable costs can be determined. It is found that the Nitinol heat engine capital costs per unit power generating capacity are approximately $0.15/W, and that the cost of produced energy for the Nitinol heat engine portion of the power plant is approximately 0.74c/kWh, including operation, maintenance, Nitinol replacements and the cost of capital for the heat engine. It is concluded that Nitinol power plants for the conversion of low grade thermal energy may have a significant economical advantage over conventionally fueled power plants. (Author)

**A83-10659#**
**LOADING SCHEMES FOR A 50 MWTH DIAGONALLY CONNECTED MHD GENERATOR**
C. C. P. PIAN and A. M. DEMIRJIAN (Avco Everett Research Laboratory, Inc., Everett, MA) Journal of Energy, vol. 6, Nov.-Dec. 1982, p. 418-424. refs
(Contract DE-AC01-80ET-15614)
(Previously cited in issue 06, p. 946, Accession no. A82-17923)

**A83-10661#**
**PERFORMANCE OF THE WELLS TURBINE AT STARTING**
S. RAGHUNATHAN (Belfast, Queen's University, Belfast, Northern Ireland) and C P. TAN Journal of Energy, vol. 6, Nov.-Dec 1982, p. 430, 431. Research supported by the Department of Energy of England.

A practical problem encountered with the Wells self-rectifying axial flow turbine is its difficulty in running up to operational speed when started from rest, a phenomenon called 'crawling' Attention is given to the influence of hub-to-tip ratio and rotor solidity on both starting and efficiency, and it is determined that to avoid crawling, a high rotor solidity and low hub-to-tip ratio, both of the order of 0.6, are required. O.C.

**A83-10665*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**END REGION EFFECTS UPON THE PERFORMANCE OF A MAGNETOHYDRODYNAMIC CHANNEL**
S. Y. WANG and J. M. SMITH (NASA, Lewis Research Center, Cleveland, OH) Journal of Energy, vol. 6, Nov.-Dec. 1982, p. 438, 439.
(Previously cited in issue 06, p. 945, Accession no. A82-17889)

**A83-10675**
**THE THEORY OF AIRCRAFT ENGINES [TEORIIA AVIATSIONNYKH DVIGATELEI]**
S. I. LOVINSKII Moscow, Izdatel'stvo Mashinostroenie, 1982. 224 p. refs

Gas turbine engines used in modern aircraft are reviewed with reference to the main engine components, the principles of engine operation, basic performance characteristics, and engine operation analysis. The engine components examined include air intake devices, various types of compressors, combustion chambers, gas turbines, and exit nozzles. Among other topics the discussion covers specific engine parameters in relation to cycle variables, engine efficiency and energy balance, operation modes, thermal and gas dynamic analyses, and approximate computation of velocity and altitude characteristics. V.L.

**A83-11021**
**POWER CONDITIONING UNIT DEVELOPMENT FOR MAG-TRANSIT**
R G. GILLILAND and R. J. SMITH (Boeing Aerospace Co., Automated Transportation Systems, Seattle, WA) In: PESC '81; Power Electronics Specialists Conference, Boulder, CO, June 29-July 3, 1981, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 297-301. Research supported by U.S. Department of Transportation.

The results of a development program which has been completed on a modular inverter, referred to as the Power Conditioning Unit (PCU), employing many parallel TO-3 transistors, are discussed. The PCU has been designed to provide a precisely controlled, variable voltage, variable frequency excitation to a linear induction motor in the MAG-TRANSIT system, a form of magnetically levitated vehicles for people mover applications. The CPU, which consists of eight power modules, with 24 transistors each, has demonstrated a capacity of 73.4 kVA. V.L.

**A83-11777**
**WIND TURBINE BLADES: A STUDY OF PROTOTYPES IN A STEADY REGIME - UNSTEADY CONSIDERATIONS [HELICES EOLIENNES: ETUDE DE PROTOTYPES EN REGIME STATIONNAIRE - ASPECTS INSTATIONNAIRES]**
R. LEBLANC, R. GOETHALS (Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Poitiers, France), and B. DE SAINT LOUVENT (Meteorologie Nationale, Etablissement d'Etude et de Recherche, Paris, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 18th, Poitiers, France, Nov 18-20, 1981, 66 p. In French. refs
(AAAF PAPER NT 81-17)

The results of comparisons of numerical models with experimental results for the performance of prototype wind turbines in steady flows are presented, along with preliminary results on behavior in unsteady flows. The numerical models are based on previous schemes devised for propellers, with modifications for small perturbations, significant radial velocity effects from the wake, and the fact that the speed is induced. Two computational methods are currently used, one a method of short blades, the other the Prandtl lifting line theory Trials have been run in the T4 wind tunnel using a 3 m horizontal axis machine and a 2.5 m Darrieus. Attention is given to modeling the structural dynamics and turbulent flow structures encountered by wind turbines Experimental results relating windspeed, angle of attack, and output are presented. Optimization studies have indicated that wind farms will require a 6-7 blade diameter unit spacing to maintain satisfactory group output efficiencies. M.S K.

**A83-11837**
**NUCLEAR ENERGY IN SPACE [KERNENERGIE IM WELTRAUM]**
H. LOEB (Giessen, Universitaet, Giessen, West Germany) Atomkernenergie/Kerntechnik, vol 40, no. 1, 1982, p. 23-30. In German. refs

The electric onboard power requirements of spacecraft have steadily increased since the launching of the first spacecraft, and power requirements of earth satellites as high as 10 kW are currently observed. Since the early 1960s, nuclear power installations in space have been used by the U.S. and the Soviet Union in connection with electric power requirements which cannot be satisfied by solar cells Such requirements are related to flights to the outer planets and the operation of spacecraft in the lunar or planetary shadow (including the shadow of the earth). Possibilities for the use of nuclear energy in space are discussed, and the employment of radioisotope batteries is considered. Questions regarding the employment of nuclear reactors in space are also investigated, taking into account principles of operation, and aspects of technical implementation. The operation of nuclear propulsion systems is also described. G.R.

**A83-11868**
**THE REBIRTH OF THE RANKINE CYCLE - ENERGY PRODUCTION ON THE BASIS OF LOW- AND MEDIUM-TEMPERATURE HEAT SOURCES [LE RENOUVEAU DU CYCLE DE RANKINE - LA PRODUCTION D'ENERGIE A PARTIR DE SOURCES DE CHALEUR A BASSE ET MOYENNE TEMPERATURES]**
A. JAUMOTTE Academie des Sciences (Paris), Comptes Rendus, Vie Academique, vol. 292, Apr. 27, 1981, p. 99-121. In French. Research supported by the Services de la Programmation de la Politique Scientifique, and Commission of the European Communities. refs

It is noted that there is renewed interest in the Rankine cycle for energy production on the basis of low- and medium-temperature heat sources. The organic-fluid Rankine cycle is shown to be

promising for power outputs less than or of the order of 1 MW; in particular, the use of freon at temperatures below 150 C is considered. A free-piston refrigerating machine operating on the basis of nonconcentrated solar energy according to the double Rankine cycle is noted as a simple, reliable, low-cost machine. At power outputs higher than 1 MW, ammonia is a working fluid of interest at low temperatures, the binary water-ammonia cycle for nuclear or fossil-fuel power plants is especially noteworthy B J.

**A83-11952**
**COMPUTATIONAL MODEL OF A DIFFUSE DISCHARGE ON ELECTRODES IN A WEAKLY IONIZED PLASMA [RASCHETNAIA MODEL' DIFFUZNOGO RAZRIADA NA ELEKTRODAKH V SLABOIONIZOVANNOI PLAZME]**
M. S. BENILOV, V. I. KOVBASIUK, and G. A. LIUBIMOV (Akademiia Nauk SSSR, Institut Vysokikh Temperatur, Moscow, USSR) Akademiia Nauk SSSR, Doklady, vol. 266, no. 4, 1982, p. 812-816. In Russian refs

**A83-12056**
**SPECTROSCOPIC STUDIES OF THE HAZARDS OF LI/SOCL2 BATTERIES DURING ANODE-LIMITED CELL REVERSAL**
D. J. SALMON, M. E. PETERSON, L. L. HENRICKS, L. L. ABELS, and J. C. HALL (Gould Laboratories, Rolling Meadows, IL) Electrochemical Society, Journal, vol 129, Nov. 1982, p. 2496-2499. refs

Experimental evidence is adduced which indicates that chlorine monoxide is formed during reversal of anode-limited Li/SOCl2 cells. Chlorine monoxide is known to be an explosive compound, and may account for explosions reported in anode-limited cells in the event that the conditions for detonation, including concentration, contact with an organic compound, and possibly contact with an initiator, are present. The uncertainty of satisfying these conditions may account for the reported unpredictability of cell explosions. O C.

**A83-12466*#** Hughes Research Labs., Malibu, Calif.
**ADVANCES IN SERIES RESONANT INVERTER TECHNOLOGY AND ITS EFFECT ON SPACECRAFT EMPLOYING ELECTRIC PROPULSION**
R R ROBSON (Hughes Research Laboratories, Malibu, CA) AIAA, Japan Society for Aeronautical and Space Sciences, and DGLR, International Electric Propulsion Conference, 16th, New Orleans, LA, Nov. 17-19, 1982, AIAA 5 p refs
(Contract NAS3-22471; NAS3-23159)
(AIAA PAPER 82-1881)

The efficiency of transistorized Series Resonant Inverters (SRIs), which is higher than that of silicon-controlled rectifier alternatives, reduces spacecraft radiator requirements by 40% and may eliminate the need for heat pipes on 30-cm ion thruster systems. Recently developed 10- and 25-kW inverters have potential applications in gas thrusters, and represent the first spaceborne SRI designs for such power levels. Attention is given to the design and control system approaches employed in these inverter designs to improve efficiency and reduce weight, along with the impact of such improved parameters on electric propulsion systems. O.C.

**A83-13460**
**CRYO-COOLER DEVELOPMENT FOR SPACE FLIGHT APPLICATIONS**
R. E. HARRIS, J. E. CHENOWETH, and R. WHITE (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH) In: Infrared astronomy - Scientific/military thrusts and instrumentation, Proceedings of the Meeting, Washington, DC, April 21, 22, 1981. Bellingham, WA, SPIE - The International Society for Optical Engineering, 1981, p 71-76. refs

Several types of cryogenic cooling systems for the focal planes and optical elements in sensors aboard orbiting spacecraft have been developed. (1) The cryogenic radiator is very reliable and requires no power consumption although it does not cool below 40 K and has a limited capacity (2) The Vuilleumier cooler has moderate efficiency but it is difficult to detach the cold section and there is a problem of wearing parts. (3) The turbo-cooler has gas film bearings, a detached cold section and a large cooling capacity, but has poor efficiency in small sizes. (4) The rotary reciprocating refrigerator has good efficiency, little vibration and a detached cold section, but it is a complex machine with complex electronics. (5) The Stirling cooler with magnetic bearings and clearance seals is highly efficient but requires a counter-mass balance system and complex electronics for its magnetic bearings S.C.S.

**A83-13650**
**A REVIEW OF UK WIND ENERGY ACTIVITIES**
P. J MUSGROVE (Reading University, Reading, Berks., England) International Journal of Solar Energy, vol 1, no. 2, 1982, p 145-160 refs

Wind power activities in Great Britain are reviewed, including a brief summary of historical windmill usage and details of developmental efforts in large and small wind turbines An annual average resource of 5 m/sec at 10 m has been extrapolated to predict an 8-10 m/sec resource at the hub heights of large wind turbines Initial estimates indicate that at least half of Great Britain's annual electricity consumption can be produced from windpowered generators. The potential of offshore large WECS siting is being examined, although the wind-derived electricity from those regions are projected to cost three times that of land-based operation. Recorded wind patterns with 12-48 hr duration have indicated that at least 20% penetration into the national grid is acceptable. A test 250 kW machine is being built as a model for a 3.7 MW machine, both intended for installation at Orkney, Scotland. Additionally, construction has begun on a 25-m diameter, vertical axis, variable geometry Musgrove wind turbine The straight-bladed machine will produce a maximum of 130 kW, and is a prototype of multi-MW offshore units. M S K.

**A83-13695**
**THE SPECTRUM OF WIND SPEED FLUCTUATIONS ENCOUNTERED BY A ROTATING BLADE OF A WIND ENERGY CONVERSION SYSTEM**
J. R. CONNELL (Battelle Pacific Northwest Laboratories, Richland, WA) Solar Energy, vol 29, no. 5, 1982, p. 363-375 refs
(Contract DE-AC06-76RL-01830)

The results of anemometer, hot-wire anemometer, and laser anemometer array and crosswind sampling of wind speed and turbulence in an area swept by intermediate-to-large wind turbine blades are presented, with comparisons made with a theoretical model for the wind fluctuations. A rotating frame of reference was simulated by timing the anemometric readings at different points of the actuator disk area to coincide with the moment a turbine blade would pass through the point. The hot-wire sensors were mounted on an actual rotating boom, while the laser scanned the wind velocity field in a vertical crosswind circle. The midfrequency region of the turbulence spectrum was found to be depleted, with energy shifted to the high end of the spectrum, with an additional peak at the rotation frequency of the rotor. A model is developed, assuming homogeneous, isotropic turbulence, to reproduce the observed spectra and verify and extend scaling relations using turbine and atmospheric length and time scales The model is regarded as useful for selecting wind turbine hub heights and rotor rotation rates. M.S.K.

**A83-13696*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**A REVIEW OF RESONANCE RESPONSE IN LARGE, HORIZONTAL-AXIS WIND TURBINES**
T. L SULLIVAN (NASA, Lewis Research Center, Cleveland, OH) Solar Energy, vol. 29, no. 5, 1982, p. 377-383. refs
(Previously announced in STAR as N82-23711) ' t No.

**A83-14041**
**BATTERIES AND FUEL CELLS: DESIGN, EMPLOYMENT, CHEMISTRY [BATTERIEN UND BRENNSTOFFZELLEN: AUFBAU, VERWENDUNG, CHEMIE]**
K.-J. EULER (Kassel, Gesamthochschule, Kassel, West Germany) Berlin, Springer-Verlag, 1982. 217 p. In German refs
$28.50

The history of electrochemical current sources is considered along with primary cells, standard cells, high-energy primary cells, high-energy storage batteries, and fuel cells. Aspects of battery research and development are also discussed, taking into account general considerations related to technological development projects, the introduction of mathematical methods into battery research, resistance measurements, autoradiography and other radiochemical methods, color photography as an aid in research, electron microscopy, X-ray and electron diffraction, spin resonance methods, and electrical measurements involving powders. Attention is given to zinc/manganese dioxide cells, zinc/mercury cells, zinc/silver oxide primary cells, cells utilizing atmospheric oxygen, lead-acid batteries, nickel-iron and nickel-cadmium storage batteries, zinc/silver storage batteries, dry cells with organic depolarizers, dry cells with solid electrolyte, and storage batteries utilizing hydrogen. G.R.

**A83-14115**
**ELECTRIC POWER SUPPLY OF AIRCRAFT [ELEKTROSNABZHENIE LETATEL'NYKH APPARATOV]**
I M. SINDEEV Moscow, Izdatel'stvo Transport, 1982. 272 p. In Russian. refs

Power supply systems of aircraft are reviewed with reference to their design, principles of operation, and maintenance. In particular, consideration is given to the drive systems of aircraft power generators, frequency and voltage control, static current converters, batteries, and power control, protection, and distribution systems. Methods of increasing the reliability of aircraft power supply systems are discussed. V.L.

**A83-14725#**
**POWER AUGMENTATION IN A SAVONIUS-TYPE WIND-TURBINE BY USING A SINGLE AIR-DEFLECTING VANE**
S. SIVAPALAN and S. SIVASEGARAM (Peradeniya, University, Peradeniya, Sri Lanka) Regional Journal of Energy, Heat and Mass Transfer, vol. 4, July 1982, p. 187-193. refs

This paper deals with the increase of power output from a vertical-axis wind-turbine of the Savonius-type by using a single deflector vane of simple geometry. Vanes of plane and circular arc sections were used in the study The respective influences of vane arc angle, vane size and angle of setting of the vane relative to the rotor on the power output were studied and so was the sensitivity of power output to wind direction Power augmentation by over 50% is seen possible with a single vane of modest size. Means of further power augmentation and achievement of direction-independent operation are discussed. (Author)

**A83-15797**
**CHARACTERISTICS OF A SAVONIUS WINDMILL POWER SYSTEM WITH A SYNCHRONOUS GENERATOR**
T. SUZUKI and H. OKITSU (Tokushima, University, Tokushima, Japan) Wind Engineering, vol. 6, no. 3, 1982, p. 131-139. refs

This paper discusses the performance characteristics of a Savonius wind turbine power system with a synchronous generator. The theoretical results agree comparatively well with the experimental results. The effects of changes in wind speed and load resistance on the performance are discussed. (Author)

**A83-15867**
**ZINC ELECTRODE MORPHOLOGY IN ALKALINE SOLUTIONS. I - STUDY OF ALTERNATING VOLTAGE MODULATION ON A ROTATING DISK ELECTRODE**
D.-T. CHIN, R. SETHI (Clarkson College of Technology, Potsdam, NY), and J. MCBREEN (Brookhaven National Laboratory, Upton, NY) (Electrochemical Society, Meeting, Minneapolis, MN, May 10-15, 1981.) Electrochemical Society, Journal, vol. 129, Dec. 1982, p. 2677-2685. refs
(Contract NSF ENG-77-25153)

The behavior and morphology of a zinc rotating disk electrode charged with superimposed square-wave alternating voltage (AV) in a concentrated alkaline zincate solution have been investigated with an AV-modulation technique. The study covered a range of AV from 0 to 200 mV rms and of frequency from 1 to 100 Hz. At low cathodic d-c overpotentials normally encountered in battery operations, AV greatly improved the current distribution and changed the nonadherent mossy zinc deposit into a compact epitaxial deposit. At higher cathodic d-c overpotentials, the effect of AV diminished; however, superimposition of AV seemed to widen the potential region for the growth of epitaxial deposit. For the anodic dissolution reaction, AV was found to increase the incidence of pitting corrosion In addition, AV behaved as a depolarizer and substantially increased the d-c current density in the voltametry measurements. (Author)

**A83-15869**
**THE EFFECT OF THICKNESS ON THE PERFORMANCE OF MOLTEN CARBONATE FUEL CELL CATHODES**
L. J. BREGOLI and H. R. KUNZ (United Technologies Corp , Power Systems Div., South Windsor, CT) Electrochemical Society, Journal, vol. 129, Dec. 1982, p. 2711-2715. Research supported by the Electric Power Research Institute. refs

Polarization data were obtained for the reduction of oxygen on porous lithiated nickel oxide fuel cell cathodes in lithium-potassium carbonate electrolyte at 650 C. Cathode thickness was varied from 0.013 to 0.112 cm with the maximum performance occurring for cathodes of approximately 0.08 cm thickness. The polarization data were optimized for each electrode by varying the electrode electrolyte content in a half-cell apparatus. The optimum content occurred when the combination of internal ionic resistive, diffusional, and activation losses resulted in minimum overvoltage. (Author)

**A83-15909**
**A RELATIVISTIC PLASMA MICROWAVE GENERATOR [RELIATIVISTSKII PLAZMENNYI SVCH GENERATOR]**
M. V. KUZELEV, F. KH. MUKHAMETZIANOV, M. S. RABINOVICH, A. A. RUKHADZE, P. S. STRELKOV, and A. G. SHKVARUNETS (Akademiia Nauk SSSR, Fizicheskii Institut, Moscow, USSR) Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki, vol. 83, Oct. 1982, p. 1358-1367 In Russian refs

Experiments are described that were aimed at achieving a microwave generator based on the interaction of a relativistic electron beam and a plasma. Results are presented for measurements of the microwave radiation parameters (wavelength, field structure, and radiant power) as a function of the beam and plasma parameters. Conditions for optimum generation in the centimeter range are determined, and a gain of 20% at a radiant power of about 100 MW is reported. The experimental results are shown to be in agreement with theoretical results obtained using a model with an infinitely strong magnetic field. F.G.M.

**A83-16000**
**TEST RESULTS OF A MEDIUM TEMPERATURE SOLAR ENGINE**
G ANGELINO, M. GAIA, E. MACCHI (Milano, Politecnico, Milan, Italy), A. BARUTTI, C. MACCIO, and G. TOMEI (Ansaldo Impianti S.p.A., Genoa, Italy) International Journal of Ambient Energy, vol. 3, July 1982, p. 115-126. refs

Design features, philosophy, and experimental results with a fluorinated organic fluid solar engine for producing 35 kWe are described. The organic fluid was chosen because of the relatively

higher efficiencies offered in comparison with other solar thermal fluid cycles. The system comprised parabolic trough collectors, a 35 kWe generator, perfluoro-dimethylcyclohexane as the working fluid, heat exchangers, regenerator, vaporizer, and condenser. A refrigerated trap was installed downstream of the incondensible extractor for recuperating the working fluid. The working fluid temperature was nominally 220-265 C at 9-14 bar pressure during trials. The total system efficiency averaged around 21 percent at a 250 C cycle temperature Use of a larger, dc generator is suggested to offer efficiency improvements. M.S.K

**A83-16019**
**EMISSION CHARACTERISTICS OF REFRACTORY MATERIALS [EMISSIONNYE KHARAKTERISTIKI TUGOPLAVKIKH MATERIALOV]**
O S. VOROBEV, M G. DOMARIN, V. B. ELISEEV, A. N. ERMILOV, I. V. ORFANOV, and S. V. RIABIKOV Akademiia Nauk SSSR, Izvestiia, Energetika i Transport, Sept.-Oct. 1982, p. 165-168. In Russian refs

Electron emission processes of refractory materials in an air plasma stream are considered. Results are presented from experimental investigations of a stream produced by an electric-arc heater of high enthalpy It is found that in many cases the density of the emission current is unusually high. A procedure is outlined for evaluating the emission efficiency of the electrodes from an analysis of the experimental volt-ampere characteristic of a two-electrode system. C.R.

**A83-16026**
**MOMENTUM THEORY, DYNAMIC INFLOW, AND THE VORTEX-RING STATE**
D. A PETERS (Washington University, St Louis, MO) and S.-Y. CHEN American Helicopter Society, Journal, vol. 27, July 1982, p. 18-24.

A more unified approach to the solution of the vortex ring state problem is obtained through the extension of criteria for the state's boundary formulated by Wolkovitch (1972). These criteria are compared with the induced flow instability of Peters (1974), and results are obtained showing a strong correlation between momentum considerations, vortex considerations, and the theory of dynamic inflow. The vortex ring state is defined as the region in which the concept of a momentum slipstream is no longer valid, and may include both helicopter and windmill conditions. O.C.

**A83-16101#**
**THERMIONICALLY EMITTING COPPER CATHODE IN CONTACT WITH COMBUSTION PLASMAS**
G. V. R RAJU, R. P. DAHIYA, and B. GUPTA (Indian Institute of Technology, New Delhi, India) Journal of Energy, vol. 7, Jan -Feb. 1983, p. 3-9. Research supported by the Council of Scientific and Industrial Research of India. refs

Current density and electrode potential drops have been investigated using a copper cathode inserted in potassium seeded combustion products of liquefied-petroleum-gas and oxygen. The work function of the composite cathode surface, formed owing to enhanced seed deposition on the inserted electrode, is observed to be much lower than the work function of pure copper. This leads to large thermionic emission of electrons from the composite cathode surface and hence, a sharp decrease in cathode potential drop. Consequently, a high current density could be sustained in the diffusive mode of current conduction The experimental observations are found to be in resonably good agreement with a theoretical model developed taking into account the thermionic emission of electrons. (Author)

**A83-16102#**
**AERODYNAMIC PLATFORM COMPARISON FOR JET-STREAM ELECTRICITY GENERATION**
C A. J. FLETCHER, A. J. HONAN, and J. S. SAPUPPO (Sydney, University, Sydney, Australia) Journal of Energy, vol. 7, Jan.-Feb 1983, p. 17-23 Research supported by the Energy Authority of New South Wales. refs

Various aerodynamic platforms are considered for suitability for deriving electricity through wind turbines placed in the jet stream. Wind tunnel, economic, and performance analyses were performed for the integrated diffuser augmented wind turbine (IDAWT), the separated DAWT (SDAWT), a separated unshrouded wind turbine (SUWT), and a rotary wing concept (RWC) The wind tunnel trials were run with models and half models of the concepts to test the lift, static stability, and power extraction capability in a 25 m/sec flow Variations in lift at varying angles of attack were also studied The results indicated that the SDAWT and the IDAWT could be built at $650/kW and produce power at an operating cost of $.05/kWh. Improvements are projected to reduce the costs to $550/kW installed with operating costs less than $ 04/kWh. The rotary wing concept was ruled out as a candidate. M S K

**A83-16103#**
**NOX FORMATION EXPERIMENTS IN AN MHD SIMULATION FACILITY**
A. G. WEHR and R TANG (Mississippi State University, Mississippi State, MS) Journal of Energy, vol 7, Jan.-Feb 1983, p 24-28. (Contract DE-AC02-80ET-15601)

(Previously cited in issue 07, p. 1112, Accession no A81-20603)

**A83-16104#**
**INFLOW DISK GENERATOR FOR OPEN-CYCLE MHD POWER GENERATION**
T. NAKAMURA, W. E. LEAR, and R. H. EUSTIS (Stanford University, Stanford, CA) Journal of Energy, vol 7, Jan.-Feb 1983, p. 29-42. Research supported by the Electric Power Research Institute refs
(Contract DE-AC01-80ET-15611)

(Previously cited in issue 07, p. 1162, Accession no. A81-20700)

**A83-16105#**
**THE STD/MHD CODES - COMPARISON OF ANALYSES WITH EXPERIMENTS**
A. A. VETTER, C. D. MAXWELL, and S T. DEMETRIADES (STD Research Corp., Arcadia, CA) Journal of Energy, vol. 7, Jan.-Feb. 1983, p. 50-56 refs
(Contract EX-76-C-01-2243)

(Previously cited in issue 08, p. 1451, Accession no A80-23953)

**A83-16106#**
**STUDY OF ELECTRICAL FAULTS IN MAGNETOHYDRODYNAMIC FARADAY GENERATORS**
S. KUO and E. LEVI (New York, Polytechnic Institute, Farmingdale, NY) Journal of Energy, vol 7, Jan.-Feb. 1983, p. 57-64. Research supported by the Electric Power Research Institute refs
(Contract ET-78-C-01-3084)

An equivalent circuit for modeling the Faraday channel is derived and used to study electrical faults external to the channel. Three faults, short circuit of one load, one load rejection, and short circuit between two adjacent anode electrodes, are considered. Numerical solutions of each fault case for the dimensions and parameters of AVCO's Mark VI facility and a projected base load plant are obtained. It is shown that short circuit of one load is the most dangerous fault in all cases and that one load rejection, while of no consequence in a small channel, could cause interelectrode arcing in a base load channel. (Author)

**A83-16107#**
**COUPLED THREE-DIMENSIONAL FLOW AND ELECTRICAL CALCULATIONS FOR FARADAY MHD GENERATORS**
S. P. VANKA and R. K. AHLUWALIA (Argonne National Laboratory, Argonne, IL) Journal of Energy, vol. 7, Jan.-Feb. 1983, p. 65-72. Research supported by the U S. Department of Energy. refs
(Previously cited in issue 17, p. 3011, Accession no. A81-38093)

**A83-16108#**
**MATHEMATICAL MODEL FOR THE ANALYSIS OF WIND-TURBINE WAKES**
M.-K. LIU, M. A. YOCKE, and T C. MYERS (Systems Applications, Inc., San Rafael, CA) Journal of Energy, vol. 7, Jan.-Feb. 1983, p. 73-78. refs
The concept of wind farms with clustered wind turbines at a given site seems to offer an attractive means for extracting wind power on a large scale. Techniques for minimizing the effect of upstream wind-turbine wakes on downstream wind turbines are needed to optimize overall performance of the wind-turbine array A numerical model for prediction of the interaction of the wind turbine with the prevailing wind flow is described The model is based on a numerical solution of the three-dimensional Navier-Stokes equations for the planetary boundary layer with the hydrostatic approximation. Three different hypothetical wind-turbine configurations are analyzed to demonstrate the utility of this model. Model predictions from the present study compare favorably with the basic characteristics of measured wind-turbine wakes
(Author)

**A83-16110#**
**EXTREMAL MHD GENERATOR**
V THIAGARAJAN (Ebasco Services, Inc., New York, NY) Journal of Energy, vol. 7, Jan.-Feb. 1983, p. 88-90
A variational criterion is derived for extremal magnetohydrodynamic generators which can be used instead of the conventional constant velocity or other design criteria The proposed variational criterion yields a range of designs which result in improved power output (and hence enthalpy extraction) with the same conditions at the inlet and exit of the generator. V.L

**A83-16111#**
**ON THE ROTARY WING CONCEPT FOR JET STREAM ELECTRICITY GENERATION**
C A J. FLETCHER (Sydney, University, Sydney, Australia) Journal of Energy, vol. 7, Jan.-Feb. 1983, p. 90-92 Research supported by the Energy Authority of New South Wales.
The limits imposed on rotor orientation, in rotary wing platforms for extracting energy from the jet stream, by the load carrying capability of Kevlar tethers used to anchor the platforms and conduct electricity were analyzed. The requirements of lift and power generation were analyzed by a blade element method to determine the power coefficient at various angles of attack. Optimal rotor radii were calculated for a platform generating 2.2 MWe for a set of tether angles, taking into account all the forces acting on the platform and rotors and also the weight of the platform. The platform weight and size was found to increase with the tether angle, with the minimum size (and costs) associated with a zero tether angle. Acceptable tether angles are determined to lie between 45-65 deg, so that the tether can support its own weight. It is concluded that the energy extraction method, using a rotary wing platform, is not feasible. M.S.K.

**A83-16112#**
**TRANSFORMATION OF WIND ENERGY BY A HIGH-ALTITUDE POWER PLANT**
G. RIEGLER, W. RIEDLER, and E. HORVATH (Graz, Technische Universitaet, Graz, Austria) Journal of Energy, vol. 7, Jan.-Feb. 1983, p. 92-94. refs
(Previously cited in issue 03, p. 399, Accession no. A82-14025)

**A83-16664#**
**DESIGN OF A LOW EMISSION COMBUSTOR FOR AN AUTOMOTIVE GAS TURBINE**
J. W. SANBORN, H. C. MONGIA, and J. R. KIDWELL (Garrett Turbine Engine Co., Phoenix, AZ) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p.
(AIAA PAPER 83-0338)
The design of a lean-burn low-emission combustor for a regenerative automotive gas turbine engine, including detailed analysis and element testing to improve premixing of fuel and air to minimize NOx emissions is described The measured emission levels for the various configurations tested are presented along with a brief description of the resulting full-scale combustion system. (Author)

**A83-16690#**
**PERFORMANCE RESULTS OF A 300 MWTH GENERATOR AT HIGH MAGNETIC FIELD**
L. S CHRISTENSEN, G. L. WHITEHEAD, and E J. FELDERMAN (Calspan Field Services, Inc., Arnold Air Force Station, TN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 11 p Research sponsored by the U S. Department of Energy and Calspan Field Services, Inc. refs
(AIAA PAPER 83-0394)
The High Performance Demonstration Experiment (HPDE) in progress at AEDC has as its objective a 300 MW thermal input open-cycle MHD system has been assembled Testing with the channel configured in the Faraday mode was initiated in late 1979 Experimental results have been obtained at a magnetic field strength from 1.5 to 3 8 Tesla (T). A maximum Faraday power of 35 5 MW has been generated, which represents an enthalpy extraction of 11 6 percent. (Author)

**A83-16691*#** Texas Univ., Arlington.
**TRANSIENT FLOW ANALYSIS OF THE AEDC/HPDE MHD GENERATOR**
D. R WILSON, Y M. LEE (Texas, University, Arlington, TX), and C. S. STEWART (General Dynamics Corp , Fort Worth, TX) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(Contract NSG-3255)
(AIAA PAPER 83-0395)
A hybrid Lax-Wendroff/Method of Characteristics computer code has been developed for numerical simulation of flow transients associated with the operation of MHD generator facilities. The code employs the shock-fitting method, with an Eulerian formulation of the basic conservation equations and explicit tracking of shock waves. Pressure, temperature, and velocity are used as primary integration variables to simplify interfacing of the code with real-gas thermodynamic and transport property tables Application of the code to the simulation of selected transients for the AEDC/HPDE MHD generator produced results that are in good agreement with experimental observations. (Author)

**A83-16732#**
**THREE-DIMENSIONAL FLUID AND ELECTRODYNAMIC MODELING FOR MHD DCW CHANNELS**
B. L. LIU, J. T LINEBERRY, and H. J. SCHMIDT (Tennessee, University, Tullahoma, TN) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p. refs
(Contract DE-AC02-79ET-10815)
(AIAA PAPER 83-0464)
A three dimensional, numerical solution for modeling diagonal conducting wall (DCW) magnetohydrodynamic (MHD) generators is developed and discussed. Cross plane gasdynamic and electrodynamic profiles are computed considering coupled MHD flow and electrical phenomena. A turbulent transport model based on the mixing length theory is used to deal with wall roughness generated turbulence effects. The infinitely fine electrode segmentation formulation is applied to simplify the governing

electrical equations. Calculations show the development of distorted temperature and velocity profiles under influence of magnetohydrodynamic interaction. Since both sidewall and electrode wall boundary losses are treated, the results furnish a realistic representation of MHD generator behavior. (Author)

**A83-16734#**
**TOROIDAL FLOW COAL-FIRED MHD COMBUSTOR DESIGN STUDY AND TESTS**
J. O. A. STANKEVICS, C. C. STEWART, and A. C J. MATTSSON (Avco Everett Research Laboratory, Inc , Everett, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 13 p. refs
(Contract DE-AC22-78ET-10787)
(AIAA PAPER 83-0467)

The design, fabrication, and testing of a prototype 20-MW (thermal) coal-fired combustor are described. The combustor design concept is based on a single-stage toroidal-flow clagging configuration that makes possible the achievement of a high overall thermal efficiency and the rejection of ash and slag particles. The vertical combustor has a cylindrical chamber, a downward flow, and a horizontal exit nozzle for directing the seeded combustion plasma to an MHD generator channel. Experiments conducted at operating pressures of up to 6 atm indicate a plasma temperature of 2650 to 2800 K, a gas conductivity of 6 to 7 mho/m, a carbon combustion efficiency of more than 99.5% and steady-state stable operation. F.G.M.

**A83-16735*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHODS OF REDUCING ENERGY CONSUMPTION OF THE OXIDANT SUPPLY SYSTEM FOR MHD/STEAM POWER PLANTS**
A. J. JUHASZ (NASA, Lewis Research Center, Cleveland, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 10 p. refs
(AIAA PAPER 83-0468)

An in-depth study was conducted to identify possible improvements to the oxidant supply system for combined cycle MHD power plants which would lead to higher thermal efficiency and reduction in the cost of electricity, COE. Results showed that the oxidant system energy consumption could be minimized when the process was designed to deliver a product O2 concentration of 70 mole percent. The study also led to the development of a new air separation process, referred to as 'liquid pumping and internal compression'. MHD system performance calculations show that the new process would permit an increase in plant thermal efficiency of 0.6 percent while allowing more favorable tradeoffs between magnetic energy and oxidant system capacity requirements. (Author)

**A83-17149**
**LIQUID PHASE THERMOCHEMICAL ENERGY CONVERSION SYSTEMS - AN APPLICATION OF DIELS-ALDER CHEMISTRY**
T. G. LENZ, L. S. HEGEDUS, and J. D. VAUGHAN (Colorado State University, Fort Collins, CO) International Journal of Energy Research, vol. 6, Oct.-Dec. 1982, p. 357-365. refs
(Contract DE-FG02-79ER-10543)

A method of thermochemical energy conversion, transport, and storage research involving moderate and low temperature liquid phase systems employing Diels-Alder cycloaddition chemistry is described. Proposed as a heat storage system for solar and industrial waste heat, the system involves the meeting, in a reactor, of energy-depleted and energy-rich fluids. The poor fluid gains energy and goes through a chemical, endothermic dissociative change. The use of Diels-Alder reactions provides completely reversible chemical reactions for this application. The heated fluid can be retransported for storage or implementation as a heat source. The return reaction, releasing the stored heat, can be done spontaneously or in the presence of a catalyst such as Lewis acids. Attention is recommended for the Wentworth-Chen temperature of 250-300 C to minimize the system thermal degradation. Research in the synthesis of diene and dienophile candidate chemicals, into sealed tube and reaction kinetic techniques, and into NMR techniques for identifying further reaction candidates are discussed. M S.K.

**A83-17371#**
**DETONATION DRIVEN INDUCTION GENERATORS WITH PARALLEL AND ANTIPARALLEL EXTERNAL AND INDUCED MAGNETIC FIELDS**
H. E. WILHELM (U.S. Navy, Michelson Laboratory, China Lake, CA) Physics of Fluids, vol. 25, Dec. 1982, p. 2401-2407. Navy-supported research. refs

Closed form solutions to initial value-problems for two types of detonation-driven induction generators are obtained with the use of Maxwell's equations. The plasma shock flows considered include an idealized jet flow featuring a constant shock speed and a plane detonation flow due to an explosive energy release. Electric current and voltage pulses induced in the generators, which have a magnetic Reynolds number much greater than one and are equipped with plane electrodes and a homogeneous external magnetic field, are calculated. The generator is regarded as having an external load circuit with a resistance and inductance connected to the downstream ends or the flow entrance ends of the electrodes, producing a magnetic self-field which is either parallel or antiparallel to the transverse external field, respectively. The generator with a positive superposition of the self-field and the transverse external field is determined to generate significantly greater power than one with a negative superposition. The jet flow also produced larger current and voltage pulses. M.S.K.

**A83-17928#**
**TECHNIQUES FOR THE SOLUTION OF MHD GENERATOR FLOWS**
C. C. P. PIAN and A. W. MCCLAINE (Avco Everett Research Laboratory, Inc., Everett, MA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 14 p. refs
(Contract DE-AC01-80ET-15614)
(AIAA PAPER 83-0465)

A procedure is presented which employs an iterative shooting approach to solve the MHD equations and their appropriate boundary conditions under the quasi-one-dimensional approximation. The different kinds of boundary conditions that must be fulfilled for the various flow situations are summarized, and design and operational constraints imposed on the analysis are reviewed. Several examples are presented to illustrate the solution procedure and to demonstrate the various considerations in the design selection process. V.L.

**A83-18457**
**THE DYNAMIC INDUCER AS A COST-EFFECTIVE WIND TURBINE SYSTEM**
G. GYATT and A. ZALAY (AeroVironment, Inc , Pasadena, CA) *In: Heat Transfer and Fluid Mechanics Institute, Meeting, 28th*, Sacramento, CA, June 28, 29, 1982, Proceedings. Sacramento, CA, CSUS University Publications, 1982, p. 165-177. refs
(Contract EG-77-C-06-1021; DE-AC02-77CH-00178; XE-1-1167-1)

The efficacy of dynamic inducer tip vanes, short airfoil sections attached perpendicularly at the outer end of wind turbine rotors, were investigated analytically and experimentally. The airfoil section is oriented to lift toward the center of the rotor, thereby forcing a greater flow toward the center of the actuator disk. Also, since the vortex shed by one tip vane posterior edge is exactly opposite in sign to the vortex produced at the anterior edge of the immediately preceeding vane, a synchronous state arises wherein drag on the tip vanes is eliminated. A numerical model was developed for the wind turbine power coefficient in a synchronous state. The simulation indicated that more kinetic energy than present in the actuator disk alone can be captured. Design features of the blades and fairing are described. Dynamic inducer WECS were projected to cost 20% less than equivalent conventional horizontal axis machines, while power augmentation can approach 70%, thus exceeding the Betz limit. D.H K.

**A83-18494#**
**RESEARCH ON OXIDATION BY AIR AND TEMPERING OF RANEY NICKEL ELECTROCATALYSTS FOR THE H2 ANODES OF ALKALI COMBUSTION MATERIALS CELLS [UNTERSUCHUNGEN ZUR LUFTOXIDATION UND TEMPERUNG VON RANEY-NICKEL-ELEKTROKATALYSATOREN FUER DIE H2-ANODEN VON ALKALISCHEN BRENNSTOFFZELLEN]**
H.-J. SELBACH Braunschweig, Technische Universitaet, Naturwissenschaftliche Fakultaet, Doktor der Naturwissenschaften Dissertation, 1982. 152 p. In German. refs

The controlled oxidation in air of Raney-nickel electrocatalysts was studied, with special attention paid to the quantitative analysis of nickel hydroxide The content of the latter was determined through X-ray studies, thermogravimetric measurements, and spectral-photometric examinations. The dependence of the content on the drying of activated catalyst is determined. The influence of nickel hydroxide on the electrochemical parameters of the catalyst, such as diffusion polarization, is studied, including a measurement of the exchange current density using the potential drop method. Conservation by oxidation in air with ancillary stabilization of the oxide in an H2 flow at 300 C is explored, including reduction by H2, the influence of tempering time, and structural studies on conserved and stabilized catalyst. Long-term research on the catalyst, including the influence of aging on the reduced catalyst, and the results of impedance measurements are presented.
C.D.

**A83-18939**
**A REVIEW OF AERO-GENERATOR FATIGUE PROBLEMS**
A. J. PRETLOVE (Reading, University, Reading, England) and P. J. WORTHINGTON (Central Electricity Generating Board, Materials Div., Leatherhead, Surrey, England) International Journal of Fatigue, vol 5, Jan. 1983, p. 15-22. refs

A review is presented of the problems of fatigue in the design of aero-generators, high technology windmills designed to generate electricity. The sources of fatigue loading for both horizontal-axis and vertical-axis machines are examined, and the effects of scaling-up from smaller to larger machines are evaluated. The fatigue performance of candidate materials for aero-generator designs, such as steels, aluminum alloys, glass-fiber composites, wood, and concrete, is discussed. Methods of fatigue assessment for aero-generator components are evaluated, including programmed loading tests and semi-empirical predictions based on known material properties.
N.B.

**A83-19609**
**A METHOD FOR ANALYZING THERMIONIC-CONVERTER BATTERIES [METOD RASCHETA BATAREI TERMOEMISSIONNYKH PREOBRAZOVATELEI]**
M. A. MENDELBAUM, A. P. SAVINOV, and V. V. SINIAVSKII Akademiia Nauk SSSR, Izvestiia, Energetika i Transport, Nov.-Dec. 1982, p. 140-147. In Russian. refs

A numerical method involving the consecutive solution of equations describing thermal and electric processes is proposed for calculating the characteristics of thermionic-converter batteries with series-parallel elements. The computational algorithm is implemented in the form of a computer program, and its efficiency is demonstrated by calculating the characteristics of a specific thermionic-converter battery. Changes in the thermal and electrical characteristics of the battery resulting from the variability of the thermal power and electric load or caused by a discontinuity in the internal electric circuit are examined.
V.L.

**N83-10134*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**PORE SIZE ENGINEERING APPLIED TO STARVED ELECTROCHEMICAL CELLS AND BATTERIES**
K. M. ABBEY and L. H. THALLER 1982 16 p refs Presented at the 17th Intersoc. Energy Conversion Eng. Conf., Los Angeles 8-13 Aug. 1982; sponsored by IEEE
(NASA-TM-82893; E-1271; NAS 1.15:82893) Avail: NTIS HC A02/MF A01 CSCL 10C

To maximize performance in starved, multiplate cells, the cell design should rely on techniques which widen the volume tolerance characteristics. These involve engineering capillary pressure differences between the components of an electrochemical cell and using these forces to promote redistribution of electrolyte to the desired optimum values. This can be implemented in practice by prescribing pore size distributions for porous back-up plates, reservoirs, and electrodes. In addition, electrolyte volume management can be controlled by incorporating different pore size distributions into the separator. In a nickel/hydrogen cell, the separator must contain pores similar in size to the small pores of both the nickel and hydrogen electrodes in order to maintain an optimum conductive path for the electrolyte. The pore size distributions of all components should overlap in such a way as to prevent drying of the separator and/or flooding of the hydrogen electrode.
Author

**N83-10135*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**POLYVINYL ALCOHOL MEMBRANES AS ALKALINE BATTERY SEPARATORS**
D. W. SHEIBLEY, O. GONZALEZ-SANABRIA, and M. MANZO 1982 23 p refs Presented at the Symp. of Membranes and Ionic and Electron. Conducting Polymers, Cleveland, 17-19 May 1982; sponsored by the Electrochemical Society
(NASA-TM-82961; E-1378; NAS 1.15:82961) Avail: NTIS HC A02/MF A01 CSCL 10C

Polyvinly alcohol (PVA) cross-linked with aldehyde reagents yields membranes that demonstrate properties that make them suitable for use as alkaline battery separators. Film properties can be controlled by the choice of cross-linker, cross-link density and the method of cross-linking. Three methods of cross-linking and their effects on film properties are discussed. Film properties can also be modified by using a copolymer of vinyl alcohol and acrylic acid as the base for the separator and cross-linking it similarly to the PVA. Fillers can be incorporated into the films to further modify film properties. Results of separator screening tests and cell tests for several variations of PBA films are discussed.
Author

**N83-10159#** Bureau of Mines, Albany, Oreg.
**ELECTROCHEMICAL DETERMINATION OF GIBBS ENERGIES OF FORMATION OF COBALT AND NICKEL SULFIDES**
S. C. SCHAEFER Jan. 1982 25 p refs
(PB82-177304; BM-RI-8588) Avail: NTIS HC A02/MF A01 CSCL 07D

The standard Gibbs energies of cobalt sulfide and nickel sulfide were determined with high temperature galvanic cells using stabilized zirconia as the electrolyte.
GRA

**N83-10348*#** AiResearch Mfg. Co., Torrance, Calif.
**A LIGHTWEIGHT ELECTRONICALLY COMMUTATED DC MOTOR FOR ELECTRIC PASSENGER VEHICLES Final Report**
E. F. ECHOLDS and P. S. WALLA 1 Sep. 1982 96 p refs
(Contract DEN3-64; DE-AI01-77CS-51044)
(NASA-CR-165601; NAS 1.26:165601; AMC-81-18266) Avail: NTIS HC A05/MF A01 CSCL 09A

A functional model breadboard converter and a rare-earth-cobalt, permanent magnet motor; as well as an engineering model converter and PM motor suitable for vehicle installations were developed and tested. The converter and motor achieved an 88% peak efficiency, a maximum output of 26 kW at 26,000 rpm, and a continuous rating of 15 kW. The system also generated power to the source during braking, with a demonstrated

peak power available at the converter terminals of approximately 26 kW at 88% efficiency. Major conclusions include: (1) the SAE J227a(D) driving cycle efficiency for the converter/motor is 86% to 88% when energy available for recovery at the converter terminals is included; (2) the converter initial cost is approximately five times that of the permanent magnet motor, but can be reduced by means of LSI logic and integrated liquid cooled semiconductor packages; and (3) an electronically commutated motor with a liquid cooled converter will operate reliably without service or maintenance for the life of a passenger vehicle. A R H.

**N83-10349*#** General Electric Co., Schenectady, N. Y. Power Electronics Lab.
**IMPROVED TRANSISTORIZED AC MOTOR CONTROLLER FOR BATTERY POWERED URBAN ELECTRIC PASSENGER VEHICLES Final Report**
S. C. PEAK Sep. 1982 242 p refs
(Contract DEN3-59; DE-AI01-77CS-51044)
(NASA-CR-167978; DOE/NASA/0059-82/1; NAS 1 26:167978; SRD-81-088) Avail: NTIS HC A11/MF A01 CSCL 09C

An ac motor controller for an induction motor electric vehicle drive system was designed, fabricated, tested, evaluated, and cost analyzed A vehicle performance analysis was done to establish the vehicle tractive effort-speed requirements These requirements were then converted into a set of ac motor and ac controller requirements The power inverter is a three-phase bridge using power Darlington transistors The induction motor was optimized for use with an inverter power source The drive system has a constant torque output to base motor speed and a constant horsepower output to maximum speed. A gear shifting transmission is not required. The ac controller was scaled from the base 20 hp (41 hp peak) at 108 volts dec to an expanded horsepower and battery voltage range. Motor reversal was accomplished by electronic reversal of the inverter phase sequence. The ac controller can also be used as a boost chopper battery charger. The drive system was tested on a dynamometer and results are presented. The current-controlled pulse width modulation control scheme yielded improved motor current waveforms. The ac controller favors a higher system voltage. A.R.H

**N83-10366#** Wisconsin Univ., Madison. Dept. of Physics.
**PROTECTION OF LARGE CAPACITOR BANKS**
J. C. SPROTT and T. W. LOVELL Jun. 1982 15 p
(Contract DE-AC02-76ET-53051)
(DE82-017353, DOE/ET-53051/41) Avail: NTIS HC A02/MF A01

Large capacitor banks, as used in many pulsed plasma experiments, are subject to catastrophic failure in the event of a short in the output or in an individual capacitor. Methods are described for protecting such banks to minimize the damage and down time caused by such a failure. DOE

**N83-10369#** Linde A.G., Hollriegelskreuth (West Germany). Werksgruppe TVT.
**REFRIGERATION SYSTEM OF SUPERCONDUCTING GENERATORS FOR LARGE POWER PLANTS Final Report, Apr. 1980**
R. GLATTHAAR Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 105 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-071; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 22

An electric generator with superconductor field windings with a capacity of 1000 to 2000 MVA was considered. No reliable equipment for refrigeration exists in order to adopt this technique in a power plant. The basic equipment, including the specifications of machines and apparatus, and a reliability study of such equipment able to function without maintenance more than 30,000 hours, were worked out The selected cooling system consists of a compressor, a battery of heat exchangers, and a dewar liquid helium storage tank at a pressure of 1.2 bars and with a capacity of 5 m3 The liquid helium flows to the generator rotor and gaseous helium with ambient conditions leaves the generator and is fed to the refrigerator for reliquification. A quantity of 5 g/sec of liquid helium is required for a generator with a capacity of 1000 MVA. The equipment and the exploitation method are described, e.g., starting of cooling the installation, starting of cooling dewar container, starting of cooling generator, stopping of installation, behavior under variable charge conditions, and short breakdown of cooling equipment. The construction and the testing of a helium cooling system is mentioned. Author (ESA)

**N83-10496** State Univ. of New York, Buffalo.
**EXTERNAL IONIZATION MECHANISMS FOR ADVANCED THERMIONIC CONVERTERS Ph.D. Thesis**
M. E. HATZIPROKOPIOU 1981 116 p
Avail: Univ. Microfilms Order No. DA8204065

Ion generation and recombination mechanisms in the cesium plasma were investigated as they pertain to the advanced mode thermionic energy converters The changes in plasma density and temperature within the converter were studied under the influence of several promising auxiliary ionization candidate sources. Three novel approaches of external cesium ion generation were investigated in some detail, namely vibrationally excited N2 as an energy source of ionization of Cs ions in a DC discharge, microwave power as a means of resonant sustenance of the cesium plasma, and ion generation in a pulse N2-Cs mixture. The experimental data obtained and discussed in this work show that all three techniques--i e the non-LTE high-voltage pulsing, the energy transfer from vibrationally excited diatomic gases, and the external pumping with a microwave power--have considerable promise as schemes in auxiliary ion generation applicable to the advanced thermionic energy converter. Dissert. Abstr.

**N83-10502*#** TRW, Inc., Redondo Beach, Calif
**DEEP DISCHARGE RECONDITIONING AND SHORTED STORAGE OF BATTERIES Final Report**
P. F. RITTERMAN May 1982 72 p refs
(Contract NAS3-21253)
(NASA-CR-167953; NAS 1.26:167953) Avail: NTIS HC A04/MF A01 CSCL 10C

The identification and measurement of hydrogen recombination in sealed nickel-cadium cells makes deep reconditioning on a battery basis safe and feasible. Deep reconditioning improves performance and increases life of nickel-cadium batteries in geosynchronous orbit applications. The hydrogen mechanism and supporting data are presented. Parameter cell design experiments are described which led to the definition of nickel-cadium cells capable of high rate overdischarge without detriment to specific energy. Nickel-cadium calls of identical optimum design were successfully cycled for 7 seasons in simulation of geosynchronous orbit at 75 percent depth-of-discharge with extensive midseason and end-of-season overdischarge at rates varying from C/20 to C/4. Destrucive physical analysis and cyclin data indicated no deterioration or the development of dangerous pressures as a result of the cycling with overdischarge Author

**N83-10504*#** Jet Propulsion Lab., California Inst of Tech., Pasadena
**CORRELATION OF DESIGN WITH PERFORMANCE OF PRIMARY LITHIUM-SULFUR OXYHALIDE CELLS**
H. A. FRANK 1 Jun. 1982 142 p refs
(Contract NAS7-100)
(NASA-CR-169369; JPL-PUB-82-30, NAS 1.26:169369) Avail: NTIS HC A07/MF A01 CSCL 10C

Results and assessments of a focused literature review of primary lithium sulfur oxyhalide cells are presented. Major emphasis is placed on the effect of component materials and designs on performance (energy density and rate capability), safety, and storage life of these cells. This information is a reference guide for the design of high energy batteries for future use on NASA missions Author

**N83-10561*#** Joint Center for Graduate Study, Richland, Wash.
**CONCEPTUAL DESIGN AND COST ANALYSIS OF HYDRAULIC OUTPUT UNIT FOR 15 KW FREE-PISTON STIRLING ENGINE Final Report**
M. A. WHITE Aug. 1982 139 p refs Prepared in cooperation with Flow Industries Inc., Kent, Wash.
(Contract DEN3-212)
(NASA-CR-165543; DOE/NASA/0212-1, NAS 1.26:165543)
Avail: NTIS HC A07/MF A01 CSCL 10B

A long-life hydraulic converter with unique features was conceptually designed to interface with a specified 15 kW(e) free-piston Stirling engine in a solar thermal dish application Hydraulic fluid at 34.5 MPa (5000 psi) is produced to drive a conventional hydraulic motor and rotary alternator. Efficiency of the low-maintenance converter design was calculated at 93.5% for a counterbalanced version and 97.0% without the counterbalance feature. If the converter were coupled to a Stirling engine with design parameters more typical of high-technology Stirling engines, counterbalanced converter efficiency could be increased to 99.6%. Dynamic computer simulation studies were conducted to evaluate performance and system sensitivities. Production costs of the complete Stirling hydraulic/electric power system were evaluated at $6506 which compared with $8746 for an alternative Stirling engine/linear alternator system Author

**N83-10568*#** Mechanical Technology, Inc., Latham, N. Y
**A CONCEPTUAL STUDY OF THE POTENTIAL FOR AUTOMOTIVE-DERIVED AND FREE-PISTON STIRLING ENGINES IN 30- TO 400-KILOWATT STATIONARY POWER APPLICATIONS Final Report**
A. VATSKY, H. S. CHEN, and J DINEEN May 1982 118 p refs
(Contract NAS3-21291)
(NASA-CR-165274; NAS 1.26:165274; MTI-82TR38) Avail: NTIS HC A06/MF A01 CSCL 10B

The technical feasibility of applying automotive-derived kinematic and free-piston Stirling engine concepts for stationary applications was explored. Automotive-derived engines offer cost advantages by providing a mature and developd engine technology base with downrating and parts commonality options for specific applications. Two engine sizes (30 and 400 kW), two Stirling engine configurations (kinematic and free-piston), and two output systems (crankshaft and hydraulic pump) were studied. The study includes the influences of using either hydrogen or helium as the working gas The first kinematic configuration selects an existing Stirling engine design from an automotive application and adapts it to stationary requirements. A 50,000-hour life requirement was established by downrating the engine to 40 kW and reducing auxiliary loads Efficiency improvements were gained by selective material and geometric variations and peak brake efficiency of 36.8 percent using helium gas was achieved. The second design was a four-cylinder, 400 kW engine, utilizing a new output drive system known as the z-crank, which provides lower friction losses and variable stroke power control. Three different material and working gas combinations were considered. Brake efficiency levels varied from 40.5 percent to 45.6 percent. A 37.5 kW single-cycle, free-piston hydraulic output design was generated by scaling one cylinder of the original automotive engine and mating it to a counterbalanced reciprocal hydraulic pump. Metallic diaphragms were utilized to transmit power. Author

**N83-10569#** Raytheon Co., Bedford, Mass Missile Systems Div.
**POWER CONDITIONING SUBSYSTEM DESIGN Interim Report, 17 Sep. 1979 - 30 Nov. 1981**
J. J. MORIARTY, A. M. HERLING, J. J. KELLEHER, and D. W. SHUTE Wright-Patterson AFB, Ohio AFWAL Jan. 1982 112 p
(Contract F33615-79-C-2079; AF PROJ. 3145)
(AD-A117736; AFWAL-TR-82-2005; BR-13058) Avail: NTIS HC A06/MF A01 CSCL 10B

This interim report describes the results of the first two phases of a three phase program to provide designs of lightweight, low volume power conditioning subsystems in the range of 500 kilowatts (kW) to 30 megawatts (MW) as part of the Air Force exploratory development program in high power airborne electrical power supply technology. These designs are based on presently available component technology such as solid state switching devices, newly developed thyratons and high energy density capacitors. Although these subsystems are to be operated in a burst mode, active cooling concepts have been utilized wherever they would result in an advantage in weight or volume. GRA

**N83-10601#** Grumman Aerospace Corp., Bethpage, N.Y.
**INVESTIGATIONS OF THE TORNADO WIND ENERGY SYSTEM**
J. T YEN Golden, Colo. Midwest Research Inst. Jun. 1982 146 p refs Prepared for Midwest Research Inst., Golden, Colo.
(Contract EG-77-C-01-4042; DE-AC02-77CH-00178; E(49-18)-2555)
(DE82-017122; SERI/TR-11052-1) Avail. NTIS HC A07/MF A01

Current test results are presented on the Tornado Wind Energy System (TWES). The performance and potential of TWES systems using wind tunnel models are discussed. Experimental results on system performance with a simple bladed turbine in both the Grumman Research Tunnel and Langley V/STOL Tunnel are presented, followed by descriptions of a larger, 15-ft model and data from tests of a 30-in turbine, as well as results from a cost analysis. It is concluded that TWES has a good commercial potential. DOE

**N83-10602#** Secord (Nelson W.), Brighton, Mich.
**WECS-LOAD CONTROLLED PITCH-VARIABLE LOAD CONVERSION TO HEAT**
N. W SECORD 29 Mar 1982 6 p
(Contract DE-FG02-81R-510309)
(DE82-014683; DOE/R5-10309/1) Avail: NTIS HC A02/MF A01

Installing a 4 kW windmill and instrumentation on a 100-ft. free-standing lattice tower, developing load control circuitry that will store excess energy in a 1000-gallon electrically heated water tank which will also provides domestic heat via a heat exchanger, and developing a torque controlled pitching hub and blade system are described Project status and costs are discussed. DOE

**N83-10603#** Sandia Labs., Albuquerque, N. Mex. Applied Mechanics Div.
**AEROELASTIC STABILITY ANALYSIS OF A DARRIEUS WIND TURBINE**
D. POPELKA Feb. 1982 37 p refs
(Contract DE-AC04-76DP-00789)
(DE82-017001; SAND-82-0672) Avail: NTIS HC A03/MF A01

An aeroelastic stability analysis was developed for predicting flutter instabilities on vertical axis wind turbines. The analytical model and mathematical formulation of the problem are described as well as the physical mechanism that creates flutter in Darrieus turbines. Theoretical results are compared with measured experimental data from flutter tests of the Sandia 2 Meter turbine. Based on this comparison, the analysis appears to be an adequate design evaluation tool. DOE

**N83-10604#** Tetra Tech, Inc., Pasadena, Calif.
**TECHNICAL AND ECONOMICAL ASSESSMENT ON TETHERED WIND-ENERGY SYSTEMS (TWES)**
O. FURUYA and S. MAEKAWA Jun. 1982 88 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-017120; SERI/TR-09172-2) Avail: NTIS HC A05/MF A01

The potential of thethered wind energy systems for energy conversion in the upper atmosphere was investigated. The vertical takeoff and landing lift generation concept had the highest potential as compared to balloon, wind and hybrid concepts. DOE

**N83-10624#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Fachbereich Mechanik.
**DEVELOPMENT OF A 5.5 M DIAMETER VERTICAL AXIS WIND TURBINE, PHASE 3 Final Report, Jun, 1982**
A. DEKITSCH, C. C ETZLER, A FRITZSCHE, G LORCH, W. MUELLER, K. ROGALLA, J. SCHMELZLE, W. SCHUHWERK, A. VOLLAN, and D. WELTE Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 52 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-086; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11

In continuation of development of a 5.5 m diameter vertical axis windmill that consists in conception, building, and wind tunnel testing, a Darrieus rotor windpowered generator feeding an isolated network under different wind velocity conditions and with optimal energy conversion efficiency was designed built, and field tested. The three-bladed Darrieus rotor tested in the wind tunnel was equiped with two variable pitch Savonius rotors 2 m in diameter By means of separate measures of the aerodynamic factors and the energy consumption, effect of revisions and optimizations on different elements was assessed Pitch adjustement of the Savonius blades, lubrication of speed reducer, rotor speed at cut-in of generator field excitation, time constant of field excitation, stability conditions, switch points of ohmic resistors which combined with a small electric battery simulated a larger isolated network connected with a large storage battery, were investigated Fundamentals for the economic series production of windpowered generators with Darrieus rotors for the control and the electric conversion system are presented. Author (ESA)

**N83-10633#** Fachhochschule, Giessen (West Germany). Labor fuer Elektrische Messtechnik.
**MEASUREMENT STUDIES OF A 15 KW WIND POWER PLANT Final Report, Sep. 1981**
U. MACHENS Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 150 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-109; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 31,50

The process in which the wind situation and the corresponding power data of the plant are recorded from instantaneous measurements is presented. This process was applied to the study of a small wind power plant, having a propeller diameter of 15 m and a power output of 15 kW at a wind speed of 9 meters/sec. The plant assembled of standard parts feeds the power to an electricity network. The plant, the synchronizing and switching of the network, the measuring procedure and the measuring equipment are described. The results of the measurements are stated and discussed. It is shown that the plant is capable of producing the expected power output. The possibilities of increasing the power output and simplifying the synchronizing and switching of the network are also indicated Author (ESA)

**N83-10634#** National Hydroelectric Power Corp. Ltd., New Delhi (India).
**SEMINAR ON ACCELERATED HYDROELECTRIC DEVELOPMENT IN INDIA: PROCEEDINGS, VOLUME 1**
Mar. 1981 359 p refs Conf. held in New Delhi, 5-6 Mar 1981 Sponsored by Central Board of Irrigation and Power 2 Vol.
(PB82-217753; CBIP-PUBL-150-VOL-1) Avail: NTIS HC A16/MF A01 CSCL 10B

Hydroelectric projects concentrating on adequacy, modernization, and acceleration are discussed. Planning and modern techniques of construction are also discussed. Contracts and coordination with power house equipment suppliers and contractors and data and technical information on hydroelectric development at high altitudes are presented. GRA

**N83-10635#** National Hydroelectric Power Corp. Ltd , New Delhi (India)
**SEMINAR ON ACCELERATED HYDROELECTRIC DEVELOPMENT IN INDIA: POST SESSION PROCEEDINGS, VOLUME 2**
May 1981 191 p refs Conf held in New Delhi, 5-6 Mar. 1981 Sponsored by Central Board of Irrigation and Power 2 Vol.
(PB82-217761; CBIP-PUBL-150-VOL-2) Avail: NTIS HC A09/MF A01 CSCL 10B

Hydroelectric projects are investigated Construction including concrete linings for tunnels and the use of laser systems in tunnelling, and powerhouse equipment suppliers and contractors are discussed. GRA

**N83-10637#** United Technologies Corp , South Windsor, Conn.
**ON THE 40KW TEST POWER PLANT MODIFICATION AND DEVELOPMENT, PHASE 2 Annual Report**
R. FALCINELLI Chicago, Ill Gas Research Inst. Jun. 1981 96 p Sponsored by Gas Research Inst
(Contract DE-AC03-77ET-11302)
(PB82-216102; GRI-77/0015, FCR-2585) Avail: NTIS HC A05/MF A01 CSCL 10B

Verification testing of an improved 40 kW onsite phosphoric acid fuel cell power plant is discussed. Results showed the power plant to operate satisfactorily within the specification examined. However, additional verification testing is required. M.G

**N83-10639#** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
**OCEAN THERMAL ENERGY AT THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY Quarterly Report, Oct. - Dec. 1981**
Jan. 1982 32 p refs
(Contract DE-AI01-82ET-20342)
(PB82-215054; OQR/81-4) Avail: NTIS HC A03/MF A01 CSCL 10A

The Johns Hopkins University Applied Physics Laboratory, under a contract with the U S. Department of Energy's Division of Ocean Energy Technology (DOE/DOET), is engaged in developing Ocean Thermal Energy Conversion (OTEC) systems that will provide synthetic fuels (e.g , methanol), energy-intensive products such as ammonia (for fertilizers and chemicals), and aluminum. The work also includes assessment and design concepts for hybrid plants, such as geothermal-OTEC (GEOTEC) plants. APL has been designated the Lead Laboratory in these areas by DOE/DOET. This Quarterly Report summarizes the work on the various tasks as of 31 December 1981. GRA

**N83-10879#** California Univ., Livermore. Lawrence Livermore Lab
**STABILITY AND DISTURBANCE OF LARGE DC SUPERCONDUCTING MAGNETS**
S. T. WANG 1981 15 p refs Submitted for publication
(Contract W-7405-ENG-48)
(DE82-012388; UCRL-86890-REV-1) Avail: NTIS HC A02/MF A01

The stability aspects of several successful dc superconducting magnets are addressed. The 12 foot bubble chamber magnets, the 15 foot bubble chamber magnets, the MFTF-Bmagnet systems, the U-25B bypass MHD magnet, and the CFFF Superconducting MHD magnet are examined. All of these magnets are cooled in pool boiling mode. Magnet design is reviewed and the adopted stability criteria, analyses of stability and disturbance, stability simulation, and the final results of magnet performance and the observed coil disturbances are discussed. DOE

**N83-10880#** Cornell Univ., Ithaca, N. Y. Dept. of Theoretical and Applied Mechanics.
**MAGNETOELASTIC INSTABILITIES AND VIBRATIONS OF SUPERCONDUCTING-MAGNET SYSTEMS Final Summary Report, Sep. 1975 - May 1979**
F. C. MOON Mar. 1982 40 p refs
(Contract DE-AS02-76ET-52042; DE-AC02-76ET-52042; EY-76-S-02-2780; NSF ENG-76-23527)
(DE82-015206; DOE/ET-52042/5; COO-2780/5) Avail: NTIS HC A03/MF A01

The structural design of superconducting magnets for magnetic fusion reactors was studied. Magnetomechanical instabilities in toroidal and poloidal field magnets for proposed fusion reactors were investigated One major accomplishment was the building and testing of a 1/75th scale superconducting structural model of a 16 coil Tokamak reactor. The buckling of toroidal and poloidal field coils under different constraints was observed. The effect of currents on natural frequencies, poloidal-toroidal coil interaction, and buckling induced superconducting normal quench of the coils were studied. The stability of poloidal coil in a toroidal magnet field were investigated with the 16 coil torus. A superconducting poloidal coil becomes statistically unstable or buckle as the current approaches a certain value. Magnetoelastic buckling of other magnet systems such as a yin-yang pair of magnets, Ioffe coils, and discrete coil solenoids are also studied. DOE

**N83-10897#** Department of Energy, Washington, D. C. Office of Energy Research.
**TECHNOLOGY SPIN-OFFS FROM THE MAGNETIC FUSION ENERGY PROGRAM**
May 1982 167 p
(DE82-016923; DOE/ER-0132) Avail NTIS HC A08/MF A01

A description of 138 possible spin offs from the magnetic fusion program is presented. The spin offs cover the following areas: (1) superconducting magnets, (2) materials technology, (3) vacuum systems, (4) high frequency and high power rf, (5) electronics, (6) plasma diagnostics, (7) computers, and (8) particle beams. DOE

**N83-10908#** General Atomic Co., San Diego, Calif
**THE DOUBLET III THOMSON-SCATTERING-SYSTEM HEMICONCENTRIC TRIPLET LENS**
D. VASLOW Dec. 1981 35 p refs
(Contract DE-AT03-76ET-51011; GEN. ATOMIC PROJ 3344)
(DE82-017384; GA-A-16738) Avail: NTIS HC A03/MF A01

The D-III Thomson Profile System Hemiconcentric Triplet lens is described This objective lens is used to image a 120 cm long segment of a focused TEM00 ruby laser beam onto a curved image plane where the light is collected by fiber optic bundles The small ports on the D-III Tokamak make it necessary to situate the objective lens aperture near the front of the lens, and to funnel the light through the narrow port opening. The hemiconcentric triplet lens aperture is located at its front surface and the refraction at this surface acts to funnel the light resulting in excellent light collection at the expense of reduced off axis resolution due to astigmatism. At the edge of the field of view the worst case resolution along the laser beam is about 3 cm The excellent correction of spherical and chromatic aberrations of this lens, however, result in minimal additional width of the light collection fiber optic bundles transverse to the beam image. DOE

**N83-10910** Columbia Univ., New York.
**PRODUCTION AND EXPERIMENTAL STUDY OF THE DISSIPATIVE TRAPPED ION INSTABILITY Ph.D. Thesis**
J T. SLOUGH 1981 167 p
Avail. Univ. Microfilms Order No. DA8204541

A steady-linear mirror machine was constructed to simulate the collisionality regime of a magnetically confined thermonuclear plasma. The collisionality regime was attained where the detrapping collision frequency from local magnetic mirrors was much less than either the electron or ion bounce frequency in the mirror. This is also the regime where the dissipative trapped ion instability (DTII) mode is predicted to be unstable. The low collisionality was accomplished with a hydrogen plasma generated by an E II B discharge source The mode was observed whenever the magnetic mirror was activated. The mode had the correct frequency and frequency dependence on both the magnetic field and the trapped fraction of plasma. The relative amplitude squared of the fluctuations, which were as large as 25% at low collisionality, had the same dependence on collisionality as the growth rate. The m = 1 mode which propagated azimuthally in the electron diamagnetic drift direction, was centered at the point of maximum radial density gradient and was confined axially to the magnetic mirror. The DTII mode exhibited all the basic features predicted by the basic dispersion relation derived for the linear geometry of the experiment, which, as is also shown, has great similarity to the results derived for toroidal geometries. Dissert. Abstr.

**N83-10917#** Nagoya Univ. (Japan) Inst. of Plasma Physics.
**SAUSAGE INSTABILITY OF Z-DISCHARGED PLASMA CHANNEL IN LIB-FUSION DEVICE**
S. KAWATA and K. NIU Jul. 1982 20 p refs
(IPPJ-602) Avail. NTIS HC A02/MF A01

The feasibility of using current carring plasma channels for transporting intense ion beams from diodes to a target in a light ion beam fusion device is addressed. Specifically, the growth rate of the most dangerous surface mode, that is, axisymmetric sausage instability is examined for the plasma channel. The growth rate is shown to be smaller than that of the plasma channel with no fluid motion in a sharp boundary. It is concluded that the stable plasma channel can be formed M.G.

**N83-10919#** Nagoya Univ. (Japan) Inst. of Plasma Physics.
**PLASMA EQUILIBRIUM AND FIELD DIFFUSION DURING CURRENT RISE PHASE OF STP-2 SCREW PINCH TOKAMAK**
A NAGATA Jun 1982 35 p refs
(IPPJ-594) Avail. NTIS HC A03/MF A01

Plasma equilibrium and field diffusion during the current rise phase of the discharge was investigated in STP-2 screw pinch tokamak. The plasma with maximum poloidal beta value beta sub p of 3 0 was obtained by compression and joule heating However the maximum beta sub p value without strong wall contacts was about 1.3 It was observed that force free current is formed in the periphery of the plasma and the penetration rate of the poloidal magnetic field is much faster than the penetration rate calculated from the classical resistivity. To understand the high beta plasma equilibrium and the mechanism of fast penetration rate observed in STP-2 plasmas, a numerical simulation was performed using a 2-D MHD pinch code TOPICS. It is demonstrated that the fast penetration rate can be explained by introducing the influx of neutral particles and the ion acoustic type anomalous resistivity M G.

**N83-10920#** Nagoya Univ. (Japan). Inst. of Plasma Physics
**US-JAPAN JOINT INSTITUTE FOR FUSION THEORY WORKSHOP ON NONEQUILIBRIUM STATISTICAL PHYSICS PROBLEMS IN FUSION PLASMAS: STOCHASTICITY AND CHAOS**
Apr. 1982 206 p refs Workshop held in Kyoto, Japan, 9-13 Nov. 1981
(IPPJ-587) Avail: NTIS HC A10/MF A01

Recent progress in the research for magnetic confinement of high temperature plasmas has revealed several important roles played by the intrinsic stochasticity of the dynamical system. Problems in the theory of magnetic confinement and heating of plasmas require deep understanding of the mathematical structures as well as the physical consequences of the intrinsic stochasticity and choas. Remarkable progress has been made in the understanding of these problems in the various fields of nonequilibnum statistical physics, such as fluid turbulence, critical phenomena, chemical turbulence, optical bistable systems, etc. This progress was realized by the introduction of modern mathematical concepts, such as mappings, bifurcations, scaling analyses, etc. L.F.M.

**N83-10921#** Nagoya Univ. (Japan) Inst. of Plasma Physics.
**US-JAPAN WORKSHOP ON BURNING PLASMA PHYSICS AND ENGINEERING**
Jul. 1982 328 p refs Workshop held in Nagoya, Japan, 10-13 Feb. 1982
(IPPJ-599) Avail. NTIS HC A15/MF A01

A burning plasma experiment to inlet tritium into a fusion device and to study burning plasma physics is discussed Tokamak reactors are discussed Radial transport of alpha particles, the effects of toroidal field ripple on superthermal particles, and magnetic surface compression heating in the heliotron device are discussed. R J.F.

**N83-10922#** Nagoya Univ (Japan). Inst. of Plasma Physics.
**US-JAPAN JOINT INSTITUTE FOR FUSION THEORY WORKSHOP ON EQUILIBRIUM, STABILITY AND TRANSPORT OF NONAXISYMMETRIC SYSTEMS**
Apr. 1981 74 p refs Workshop held at Nagoya, Japan, 14-18 Dec. 1981
(IPPJ-577) Avail: NTIS HC A04/MF A01

Theoretical aspects of stellarator/torsatron/heliotron, bumpy torus and tandom mirror are discussed Main topics are equilibrium, stability and related beta limits in each confinement system New types of stellarator with helical magnetic axis were also presented. L.F.M.

**N83-10925** California Inst. of Tech., Pasadena
**MEASUREMENTS OF MAGNETIC FIELD FLUCTUATIONS IN THE CALTECH RESEARCH TOKAMAK Ph.D. Thesis**
M. A. HEDEMANN 1982 128 p
Avail: Univ. Microfilms Order No DA8203355

An experimental investigation of magnetic field fluctuations in a research Tokamak plasma was performed. The fluctuations were measured with movable probes inserted directly into the plasma. Estimates of the fluctuating field strength, power spectra density, and correlation lengths were made by calculations on the raw data. The fluctuations were found to be of comparable strength for the radial and poloidal components, while the toroidal component was found to be at least a factor of 5 weaker in strength. The fluctuating field strength showed no apparent dependence on plasma current and safety factor at the edge, but increased with electron density during gas puffing and as the minor radius of measurement was decreased The power spectral density indicated that the fluctuations could be divided into two frequency regions. The low frequency regions. The low frequency regions. The low frequency region (f 100 kHz) was dominated by coherent MHD modes with correlation lengths on the order of the Tokamak size. The high frequency region appeared to be turbulent in nature with short correlation lengths in the poloidal direction, but longer correlation lengths in the radial direction The results are compared with theories of fluctuation sources and the effects of fluctuations on anomalous electron thermal transport. Dissert Abstr.

**N83-10926** Princeton Univ., N J.
**MEASUREMENTS OF FUSION REACTIONS FROM A TOKAMAK PLASMA Ph.D. Thesis**
R. E. CHRIEN 1981 121 p
Avail: Univ. Microfilms Order No. DA820322

Tokamak fusion reaction diagnostics were extended to include measurements of d-t, dp-3He, and d-d (proton branch) reactions. The confinement and slowing down of 1 MeV d-d tritons were studied y measuring d-t meutrons. The first charged fusion products to be detected in a Tokamak were the 3 MeV d-d and 14.7 MeV d- 3He protons. Beam-target d-3He reactions were measured during deuterium beam injection to study the transport and vessel retention of helium Large d-3He reaction rates were produced by ion cyclotron heating of a 3He minority in a deuterium plasma Measurements of the reaction rate, energy spectrum, and decay time indicate that the reactions are produced by 200 - 400 keV3He ions. Sawtooth and m = 2 oscillations in the proton emission were observed. Dissert. Abstr

**N83-10928#** Oak Ridge National Lab., Tenn. Fusion Energy Div.
**CURVILINEAR COORDINATES FOR MAGNETIC CONFINEMENT GEOMETRIES**
S. P. HIRSHMAN Aug. 1982 25 p refs
(Contract W-7405-ENG-26)
(DE82-019733; ORNL/TM-8393) Avail: NTIS HC A02/MF A01

The basic properties of curvilinear coordinates are reviewed. Some applications to the description of three dimensional magnetic confinement geometries are cited. The notation used attempts to be consistent with the literature, and the relation to differential geometry is stressed. DOE

**N83-10930#** California Univ., Berkeley Lawrence Berkeley Lab
**ACCELERATOR AND FUSION RESEARCH DIVISION**
D. L. JUDD Jan. 1982 36 p refs
(Contract W-7405-ENG-48)
(DE82-012361; LBL-14038) Avail: NTIS HC A03/MF A01

Transverse and longitudinal phase volumes are evaluated and dilution factors defined. A simpler expression for the effect of third-order geometric aberrations is given. Constraints on the final quadrupole bore radius are discussed. Parameters of the example design are considered and analyzed. The available dilution factor allows a comparison between the present induction linac example design and the rf linac designs available in 1978. Phase-space limitation on attaining high power density for spot heating experiments is discussed. DOE

**N83-10931#** Occidental Research Corp., Irvine, Calif
**STUDY OF ION BEAM-INITIATED INERTIAL-CONFINEMENT FUSION Final Report, 1 Jan. - 31 Dec. 1981**
D. CHANG and D PHELPS Feb 1982 92 p refs
(Contract DE-AC08-81DP-40138)
(DE82-013935, DOE/DP-40138/1) Avail. NTIS HC A05/MF A01

A fusion program which is based on a reactor concept in which geometrically focused and time compressed beams of cold light ions and neutralizing cold electrons from large area sources are ballistically propagated over several meters through a near vacuum to implode a pellet target is discussed. The approach combines the cost advantage of efficient moderate voltage pulsed power technology with the simplicity advantage of unguided ballistic propagation. In addition, the compactness, efficiency, focusability and energy range of the system makes the approach of great interest for supplementary heating of magnetically confined fusion plasmas. Beam target interaction, beam prpagation and source accelerator design were analyzed. A one dimensional implosion and nuclear burn code indicates that significant yields can be obtained from simple targets with moderately energetic light ions The short term objective is to demonstrate that the required degree of space time focusing can be achieved on a 200-500 keV electron neutralized ion (or plasma) beam from a simple prototype 100 sq cm low temperature zeolite source. DOE

**N83-10932#** Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
**RADIAL EFFECTS IN HEATING AND THERMAL STABILITY OF A SUB-IGNITED TOKAMAK**
V. FUCHS, M. M. SHOUCRI, G. THIBAUDEAU, L. HARTEN, and A. BERS Feb. 1982 86 p refs
(Contract DE-AC02-78ET-51013; NSF ENG-79-070947)
(DE82-009384; DOE/ET-51013/32; PFC/RR-82-6) Avail: NTIS HC A05/MF A01

The existence of thermally stable subignited equilibria of a Tokamak reactor, sustained in operation by a feedback controlled supplementary heating source, was demonstrated. The establishment of stability depends on a number of radially nonuniform, nonlinear processes whose effect is analyzed. One dimensional (radial) stability analyses of model transport equations, together with numerical results from a 1-D transport code, are used to study the heating of DT plasmas in the thermonuclear regime. It is found that plasma core supplementary heating is a

thermally more stable process than bulk heating. In the presence of impurity line radiation, however, core heated temperature profiles may collapse, contracting inward from the limiter, the result of an instability caused by the increasing nature of the radiative cooling rate, with decreasing temperature. Conditions are established for the realization of a subignited high-Q, toroidal reactor plasma with appreciable output power (approx. = 2000 MW thermal). DOE

**N83-10933#** Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
**ANTENNA-PLASMA COUPLING THEORY FOR ICRF HEATING OF LARGE TOKAMAKS**
A. RAM and A. BERS Mar. 1982 8 p refs Presented at the 3rd Joint Varenna-Grenoble Intern. Symp. on Heating in Toroidal Plasmas, Grenoble, France, 22-27 Mar. 1982
(Contract DE-AC02-78ET-51013)
(DE82-013226; DOE/ET-51013/38, PFC/CP-82-2; CONF-820345-8) Avail: NTIS HC A02/MF A01

The coupling characteristics of antenna structure were studied by analyzing a model where a thin current sheet is placed between a fully conducting wall and a sheet of anisotropic conductivity representing the screen. The inhomogeneous plasma in the shadow of the limiter is assumed to extend from the screen onwards away from the antenna. The excitation of the fields inside the plasma are found by analyzing the radiation properties of this current sheet antenna. In all experiments to-date, the cross-sectional plasmas are relatively small so that the RF conductor is a half-loop around the plasma in the poloidal direction. For reactor size plasmas, this cannot be done and the antenna dimensions will be small compared to the plasma cross-sections DOE

**N83-10934#** Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
**LOWER HYBRID RF CURRENT DRIVE AND ELECTRON-CYCLOTRON HEATING ON THE VERSATOR 2 TOKAMAK**
S C. LUCKHARDT, S. F. KNOWLTON, M. PORKOLAB, G. BEKEFI, P. I. BONOLI, K. I. CHEN, B. COPPI, R. C. ENGLADE, A. S FISHER, K. E. HACKETT et al. Apr. 1982 21 p refs Presented at third Joint Varenna-Grenoble Symp. on Heating in Toroidal Plasmas, Grenoble, France, 22-27 Mar. 1982 Prepared in cooperation with NRL, Washington, D.C.
(Contract DE-AC02-78ET-51013)
(DE82-017127, DOE/ET-51013/40; PFC/CP-82-4; CONF-820345-14) Avail: NTIS HC A02/MF A01

Lower-hybrid current drive experiments (LHCD) have been carried out on the Versator 2 Tokamak in which RF injection for pulse lengths longer than the plasma L/R time generated large increases in the net toroidal current. Incremental increases, (RADICAL)I/I, of more than 35% were obtained. These current rises are strongly dependent on the relative phasing between waveguides, (RADICAL)phi = -900. In typical cases, Thomson scattering measurements during RF drive show a decrease in the central electron temperature from 240 Ev + or - 45 eV to 120 eV + or - 20 eV due to the spontaneous reduction in ohmic heating power during RF drive. DOE

**N83-10935#** Los Alamos Scientific Lab., N Mex. CTR Div.
**BEHAVIOR OF A PLASMA IN A HIGH-DENSITY GAS-EMBEDDED Z-PINCH CONFIGURATION Thesis**
J. S. SHLACHTER May 1982 198 p refs
(Contract W-7405-ENG-36)
(DE82-017396; LA-9333-T) Avail: NTIS HC A09/MF A01

A high density Z pinch is analyzed by examining the steady state energy balance between ohmic heating and bremsstrahlung radiation losses for a plasma column in pressure equilibrium. The model is expanded to include the time-varying internal energy and results in a quasi-equilibrium prescription for the load current through a constant radius plasma channel. This set of current waveforms is useful in the design of experimental systems. The behavior of a plasma for physically realizable conditions is first examined by allowing adiabatic changes in the column radius A more complete model is then developed by incorporating inertial effects into the momentum equation, and the resultant global MHD computational computer simulations. These comparisons demonstrate the advantages of the global MHD description over zero dimensional models DOE

**N83-10937#** Argonne National Lab., Ill.
**DEMONSTRATION TOKAMAK POWER PLANT STUDY Interim Report**
Mar. 1982 582 p refs
(Contract W-31-109-ENG-38)
(DE82-016182; ANL/FPP/TM-154) Avail: NTIS HC A25/MF A01

A Tokamak power plant was studied This design manual covers the following areas: (1) steady-state current drive, (2) impurity control and exhaust, (3) first wall and blanket, and (4) configuration and maintenance. DOE

**N83-10938#** Argonne National Lab., Ill Fusion Power Program.
**WILDCAT: A CATALYZED D-D TOKAMAK REACTOR**
K. EVANS, JR., C C. BAKER, J N. BROOKS, R. G. CLEMMER, D. A. EHST, H. HERMAN, J. JUNG, R F. MATTAS, B MISRA, and D. L. SMITH Nov. 1981 246 p refs
(Contract W-31-109-ENG-38)
(DE82-013712; ANL/FPP/TM-150) Avail: NTIS HC A11/MF A01

The WILDCAT is a conceptual design of a catalyzed D-D, Tokamak, commercial, fusion reactor. The WILDCAT utilizes the beneficial features of no tritium breeding, while not extrapolating unnecessarily from existing D-T designs. The reactor is larger and has higher magnetic fields and plasma pressures than typical D-T devices. It is more costly, but eliminates problems associated with tritium breeding and has tritium inventories and throughputs approximately two orders of magnitude less than typical D-T reactors There are two versions, a steady state one with Alfven wave current drive and a pulsed version. Comparison with D-T devices were made, and cost and safety analyses are included All of the major reactor systems are worked out to a level of detail appropriate to a complete, conceptual design. DOE

**N83-10939#** Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
**OBSERVATION OF THE PARAMETRIC DECAY INSTABILITY DURING ELECTRON CYCLOTRON RESONANCE HEATING ON THE VERSATOR 2 TOKAMAK**
F. S. MCDERMOTT, G. BEKEFI, and M PORKOLAB Mar. 1982 22 p refs
(Contract DE-AC02-78ET-51013)
(DE82-012573; DOE/ET-51013/37; PFC/RR-82-9) Avail: NTIS HC A02/MF A01

A nonlinear, three wave interaction process occurring during high power electron cyclotron heating in the Versator II Tokamak were observed. The measured spectra and the threshold power are consistent with a model in which the incident power in the extraordinary mode of polarization decays at the upper hybrid resonance layer into a lower hybrid wave and an electron Bernstein wave. DOE

**N83-10940#** Oak Ridge National Lab., Tenn. Fusion Energy Div.
**RIPPLING MODES IN THE EDGE OF A TOKAMAK PLASMA**
B. A. CARRERAS, J. D. CALLEN (Wisconsin Univ., Madison), P. W. GAFFNEY, and H. R. HICKS Feb. 1982 52 p refs
(Contract W-7405-ENG-26)
(DE82-007724; ORNL/TM-7989) Avail: NTIS HC A04/MF A01

A promising resistive magntohydrodynamic candidate for the underlying cause of turbulence in the edge of a Tokamak plasma is the rippling instability. A computational model for these modes in the cylindrical Tokamak approximation was developed and the linear growth and single helicity quasilinear saturation phases of the rippling modes for parameters appropriate to the edge of a Tokamak plasma was explored. Large parallel heat conduction does not stabilize these mode. Nonlinearly, individual rippling modes

are found to saturate by quasilinear flattening of the resistivity profile. The saturated amplitude of the modes scales as m/sup -1/, and the radial extent of these modes grows linearly with time due to radial Vector E x Vector B0 convection. It is found that this evolution is terminated by parallel heat conduction. DOE

**N83-10941#** Science Applications, Inc., Boulder, Colo. Plasma Research Inst.
**INSTABILITIES DRIVEN BY THE PARALLEL VARIATION OF THE ELECTROSTATIC POTENTIAL IN TANDEMS**
X. S. LEE, P. J. CATTO, and R. E. AAMODT May 1982 10 p refs
(Contract DE-AC03-76ET-53057)
(DE82-018409; SAI-254-82-134-LJ; PRI-42) Avail: NTIS HC A02/MF A01

It is demonstrated that the free energy associated with the sheared flow induced by the parallel variations of drift frequencies can provide a new destabilizing term. In particular, it is shown that a magnetohydrodynamic-like instability may occur in the mirror end plugs or thermal barrier region of a tandem mirror fusion device. DOE

**N83-10942#** Oak Ridge National Lab., Tenn. Fusion Energy Div.
**RESISTIVE MHD STUDIES OF HIGH-BETA TOKAMAK PLASMAS**
V. E. LYNCH, H R HICKS, J. A. HOLMES, B. A. CARRERAS, and L GARCIA Feb. 1982 49 p refs Sponsored in part by the US-Spanish Joint Committee for Scientific and Technical Cooperation
(Contract W-7405-ENG-26)
(DE82-008101; ORNL/TM-8082) Avail: NTIS HC A03/MF A01

The magnetohydrodynamic (MHD) activity in high beta Tokamaks such as ISX-B was calculated. These initial value calculations are built on earlier low beta techniques, but the beta effects create several new numerical issues. In addition to time stepping modules, the system of computer codes includes equilibrium solvers (used to provide an initial condition) and output modules, such as a magnetic field line follower and an X-ray diagnostic code. The transition from current driven modes a low beta to predominantly pressure driven modes at high beta is described The nonlinear studies yield X-ray emissivity plots which are compared with experiment. DOE

**N83-10943#** Oak Ridge National Lab., Tenn. Fusion Energy Div.
**FUSION REACTOR PLASMA-PERFORMANCE MODELING: POPCON ANALYSIS**
W A HOULBERG, S. E. ATTENBERGER, and L. M. HIVELY Jun. 1982 42 p refs
(Contract W-7405-ENG-26)
(DE82-016364; ORNL/TM-8282) Avail: NTIS HC A03/MF A01

A method of analyzing plasma performance over large regions of density and temperature space with time-dependent multidimensional transport codes is presented. Contour plots of global plasma parameters are shown to be a valuable tool for determining the impact of very detailed physics on plasma performance. Tokamak reactor applications illustrate the importance of plasma geometry and profile effects on both steady-state and startup behavior. DOE

**N83-10945#** Los Alamos Scientific Lab., N. Mex.
**PARAMETRIC SYSTEMS ANALYSIS OF THE MODULAR STELLARATOR REACTOR (MSR)**
R. L. MILLER, R. A. KRAKOWSKI, and C. G. BATHKE May 1982 43 p refs
(Contract W-7405-ENG-36)
(DE82-016244; LA-9344-MS) Avail: NTIS HC A03/MF A01

The close coupling in the stellarator/torsatron/heliotron (S/T/H) between coil design, magnetics topology, and plasma performance complicates the reactor assessment more so than for most magnetic confinement systems. To provide an additional degree of resolution of this problem for the Modular Stellarator Reactor (MSR), a parametric systems model was applied. This model reduces key issues associated with plasma performance, first wall/blanket/shield (FW/B/S), and coil design to a simple relationship between beta, system geometry, and a number of indicators of overall plant performance The results are used to guide more detailed, multidimensional plasma, magnetics, and coil design efforts towards technically and economically viable operating regimes. It is shown that beta values 0.08 may be needed if the MSR approach is to be substantially competitive with other approaches to magnetic fusion in terms of system power density, mass utilization, and cost for total power output around 4.0 GWt; lower powers will require even higher betas. DOE

**N83-10947#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept of Nuclear Engineering.
**NEUTRON ATTENUATION IN THE LASER DUCTS OF AN INERTIAL-CONFINEMENT FUSION REACTOR**
F. AUGUSTINE, JR. Nov. 1981 107 p refs
(Contract DE-AC02-77ET-51010)
(DE82-007195; WFPS-TME-81-031) Avail: NTIS HC A06/MF A01

Neutron streaming through the laser beam ducts of an inertial confineent fusion power plant is discussed The neutron flux through these ducts must be attenuated by a factor of 10(12) to meet radiological safety limits. Mirrors are used to bend the path of the laser beam while cutting off a line of sight path for neutrons The Monte Carlo Code MCNP was used to analyze the two mirror SOLASE design, which only attenuated the neutron flux by a factor of 10(3). The Westinghouse design, attenuated the neutron flux by 10(4) per mirror bend, and three mirror bends were needed It is also revealed that the large length/diameter ratio of the ducts and the thinner mirror design are crucial to the large attenuation. It is suggested that a two mirror system can be developed, at 10(6) attenuation per mirror bend by utilizing point cross overs, a second flux trap, and acute column to column angles. DOE

**N83-10949#** Oak Ridge National Lab., Tenn. Fusion Energy Div.
***SECOND-CYCLOTRON-HARMONIC EMISSION MEASUREMENTS ON ISX-B***
A. G. KULCHAR (Tennessee Univ.), J. B WILGEN, A. C. ENGLAND, O. C. ELDRIDGE, C. M. LORING, G. BEKEFI (MIT), and K. E. HACKETT (MIT) Apr. 1982 33 p refs
(Contract W-7405-ENG-26)
(DE82-009938; ORNL/TM-8200) Avail: NTIS HC A03/MF A01

Second harmonic cyclotron radiation was used to measure the electron temperature during electron cyclotron heating (ECH) on the Impurity Study Experiment (ISX-B) tokamak. The 58-GHz and 70-GHz microwave superheterodyne receivers used for the measurements are described in detail. The limitations of the use of cyclotron radiation for a temperature measurement are quantified in terms of both the density and the temperature. A comparison is made between the results from the microwave diagnostics and those from the laser Thomson scattering to demonstrate that the cyclotron emission is thermal. A brief discussion of sensitivity to runaways and to other nonthermal populations is given. DOE

**N83-10951#** Georgia Inst. of Tech., Atlanta. School of Nuclear Engineering.
**REVIEW OF PLASMA-IMPURITY SOURCES DURING TOKAMAK OPERATION**
B. DEWALD Jan. 1982 51 p refs
(Contract DE-AS05-78ET-52025)
(DE82-017098, GTFR-30) Avail: NTIS HC A04/MF A01

A general review is given on the present status of understanding plasma impurity sources which occur during nondisruptive Tokamak operation Included in the review are the processes of arcing, physical sputtering, neutron sputtering, desorption, chemical erosion, blistering, and backscattering. Excluded from the study are vaporization sources which are associated with the breakdown and initial startup phases of the plasma burn and major disruptions The aspects of each impurity source which is discussed cover the theoretical and empirical models, the significant of the impurity

yield, and the relevance of the process in consideration of near term and future Tokamak plasma edge conditions. DOE

**N83-10952#** Columbia Univ., New York. School of Engineering and Applied Science.
**OBSERVATIONS OF PLASMA ROTATION IN THE HIGH-BETA TOKAMAK TORUS 2**
C. KOSTEK and T. C. MARSHALL 1982 30 p refs
(Contract DE-AC02-76ET-53016)
(DE82-019373; DOE/ET-53016/78) Avail: NTIS HC A03/MF A01

Toroidal and poloidal plasma rotation are measured in a high Beta Tokamak device by studying the Doppler sift of the 4686 A He II line. The toroidal flow motion is in the same direction as the plasma current at an average velocity of 1.6 x 10(6) cm/sec, a small fraction of the ion thermal speed. The poloidal flow follows the ion diamagnetic direction, also at an average speed of 1.6 x 10(6) cm/sec. The toroidal flow is compared with the predictions of neoclassical transport theory in the collisional regime. Mechanisms for the time evolution of the rotation are also examined. E.A.K.

**N83-10953#** Oak Ridge National Lab., Tenn. Physics Div
**FARADAY-ROTATION MEASUREMENTS IN ISX-B**
D. P. HUTCHINSON, C. H. MA, P. A. STAATS, and K. L. VANDERSLUIS 1982 16 p refs
(Contract W-7405-ENG-26)
(DE82-011507; DOE/NBM-2011507) Avail: NTIS HC A02/MF A01

A submillimeter wave phase modulated polarimeter/interferometer is used for simultaneous time dependent measurement of line averaged electron density and poloidal field induced Faraday rotation along chords of the plasma column in ISX-B Tokamak. Heterodyne detection and hollow dielectric waveguide are utilized to achieve the high sensitivity required for the multichord experiment. A data analysis code is developed to reconstruct the asymmetric distributions of plasma density. The validity of the code is examined, and good agreement with density profiles measured by Thomson scattering are shown. DOE

**N83-10957#** Oak Ridge National Lab., Tenn. Fusion Energy Div.
**NEUTRAL-BEAM DEPOSITION IN LARGE, FINITE-BETA NONCIRCULAR TOKAMAK PLASMAS**
R. M. WIELAND and W. A. HOULBERG Feb. 1982 37 p refs
(Contract W-7405-ENG-26)
(DE82-008146; ORNL/TM-7658) Avail: NTIS HC A03/MF A01

A parametric pencil beam model which describes the attenuation of an energetic neutral beam moving through a Tokamak plasma is discussed. The nonnegligible effects of a finite beam cross section and noncircular shifted plasma cross sections are accounted for by using a smoothing algorithm dependent linearly on beam radius and by including information on the plasma flux surface geometry explicitly. The model is benchmarked against more complete and more time consuming two dimensional Monte Carlo calculations for the case of a large D-shaped Tokamak plasma with minor radius a = 120 cm and elongation b/a = 1.6. Deposition profiles are compared for deutenum beam energies of 120 to 150 keV, central plasma densities of 8 x 10(13) - 2 x 10(14) cm(+3), and beam orientation ranging from perpendicular to tangential to the inside wall. DOE

**N83-10958#** Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
**METHODS TO ENHANCE BLANKET POWER DENSITY**
P. Y. HSU, L. G. MILLER, T. S. BOHN, G. A. DEIS, G. R. LONGHURST, L. S. MASSON, D. E. WESSOL, and M. A. ABDOU (Argonne National Lab., Ill.) Jun. 1982 25 p refs
(Contract DE-AC07-76ID-01570)
(DE82-017467; EGG-FT-5885) Avail: NTIS HC A02/MF A01

The extent to which the power density in the FED/INTOR breeder blanket test modules can be enhanced by artificial means was investigated. It is assumed that a viable approach can be developed which will allow advanced reactor blanket modules to be tested on FED/INTOR under representative conditions. DOE

**N83-10991*#** Mechanical Technology, Inc., Latham, N. Y.
**AUTOMOTIVE STIRLING ENGINE MOD 1 DESIGN REVIEW, VOLUME 2 Final Report**
Aug. 1982 573 p
(Contract DEN3-32; DE-AI01-77CS-51040)
(NASA-CR-167936; DOE/NASA/0032-17-VOL-2; NAS 1.26:167936; REPT-80ASE142DR1-VOL-2) Avail: NTIS HC A04/MF A01 CSCL 13F

The auxiliaries and the control system for the ASE MOD I: (1) provide the required fuel and air flows for a well controlled combustion process, generating heat to the Stirling cycle; (2) provide a driver acceptable method for controlling the power output of the engine; (3) provide adequate lubrication and cooling water circulation; (4) generate the electric energy required for engine and vehicle operation; (5) provide a driver acceptable method for starting, stopping and monitoring the engine; and (6) provide a guard system, that protects the engine at component or system malfunction. The control principles and the way the different components and sub-systems interact are described as well as the different auxiliaries, the air fuel system, the power control systems and the electronics. The arrangement and location of auxiliaries and other major components are also examined. A.R.H.

**N83-11063*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**COLD-AIR PERFORMANCE OF COMPRESSOR-DRIVE TURBINE OF DEPARTMENT OF ENERGY UPGRADED AUTOMOBILE GAS TURBINE ENGINE. 2: STAGE PERFORMANCE**
R. J. ROELKE and J. E. HAAS Oct. 1982 18 p refs Prepared in cooperation with Army Aviation Research and Development Command, Cleveland
(Contract EC-77-A-31-1011)
(NASA-TM-82818; DOE/NASA/1011-36, NAS 1 15:82818; AVRADCOM-TR-82-C-1) Avail: NTIS HC A02/MF A01 CSCL 10B

The aerodynamic performance of the compressor-drive turbine of the DOE upgraded gas turbine engine was determined in low temperature air. The as-received cast rotor blading had a significantly thicker profile than design and a fairly rough surface finish. Because of these blading imperfections a series of stage tests with modified rotors were made These included the as-cast rotor, a reduced-roughness rotor, and a rotor with blades thinned to near design. Significant performance changes were measured Tests were also made to determine the effect of Reynolds number on the turbine performance. Comparisons are made between this turbine and the compressor-drive turbine of the DOE baseline gas turbine engine. Author

**N83-11397#** Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Electrical, Computer and Systems Engineering.
**DIGITAL IMAGE TRANSMISSION AND CODING**
J. W. MODESTINO (California Univ. at San Diego, La Jolla) *In* AGARD Image Process. Tech. 8 p May 1982 refs
Avail. NTIS HC A11/MF A01

A survey is provided of digital processing techniques for the coding, transmission and remote reconstruction of imagery data. The coding techniques considered include PCM, DPCM, and its logical extension tree coding, as well as block transform techniques. Particular emphasis is given to the effects of channel errors on each of these techniques, as well as techniques for combatting these effects. Combined source channel coding approaches which have proven particularly effective in optimizing image reconstruction quality subject to a constraint on the overall transmission bandwidth are considered. Author

**N83-11504#** Milwaukee School of Engineering, Wis. Fluid Power Inst.
**BREAK-IN, PERFORMANCE AND ENDURANCE TESTS RESULTS ON FIXED DISPLACEMENT HYDRAULIC FLUID POWER VANE PUMPS Final Report, Dec. 1980 - Jun. 1982**
15 Jul. 1982 497 p
(Contract DAAK70-81-C-0002)
(AD-A117962; REPT-50423) Avail: NTIS HC A21/MF A01 CSCL 13K

This report summarizes the results obtained in evaluation 21 vane pumps from three different manufacturers on overall performance, accelerated life, 1000 hour endurance and thermal stability tests using clean oil. GRA

**N83-11579*#** Kaman Aerospace Corp., Bloomfield, Conn
**DESIGN AND FABRICATION OF COMPOSITE BLADES FOR THE MOD-1 WIND TURBINE GENERATOR Final Report**
W. R. BATESOLE and C T. GUNSALLUS Nov. 1981 106 p refs
(Contract DEN3-131; DE-AI01-76ET-2030)
(NASA-CR-167987; DOE/NASA/0131-1; NAS 1.26:167987; RR-1685) Avail: NTIS HC A06/MF A01 CSCL 10B

The design, tooling, fabrication, quality control, and testing phases carried out to date, as well as testing still planned are described. Differences from the 150 foot blade which were introduced for cost and manufacturing improvement purposes are discussed as well as the lightning protection system installed in the blades Actual costs and manhours expended for Blade No. 2 are provided as a base, along with a projection of costs for the blade in production A.R.H.

**N83-11590#** Maschinenfabrik Augsburg-Nuernberg A.G., Augsburg (West Germany). Neue Technologie.
**TEST PROGRAM FOR WIND ENERGY CONVERSION SYSTEM GROWIAN Final Report, Sep. 1981**
F KOERBER Bonn Bundesministerum fuer Forschung und Technologie Jun 1982 132 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-072; ISSN-0340-7608) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 27,50

The planned test program for wind energy conversion is described. Measurements made of wind distribution, efficiency of energy conversion, dynamic effects, electric behavior, optimization of control, and environmental impact, like sound and TV interferences are discussed. Wind distribution is measured far enough in front of the windmill, just before the blades, and behind the rotor by a grid arrangement of anemometers covering entirely the rotor area in 25m steps. Measuring programs carried out on other windmills, location of measurement instruments, protection against lightning, and computation of data are reviewed. A proposal for measurement procedures and data processing is made.
Author (ESA)

**N83-11601#** AEG-Telefunken, Frankfurt am Main (West Germany). Inst. of Physical Chemistry.
**CRUDE GAS/AIR FUEL CELLS WITH A PHOSPHORIC ACID MATRIX Final Report, Apr. 1981**
R. FLEISCHMANN Bonn Bundesministerum fuer Forschung und Technologie Aug. 1982 48 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerum fuer Forschung und Technologie
(BMFT-FB-T-82-167, DK-621.352.6.035.2; ISSN-0340-7608) Avail. NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 10,10

Further development of the phosphoric acid matrix cell with tungsten carbide anodes was undertaken in order to increase the reliability of materials and production process, increase capacity, and reduce maintenance. This led to the long duration testing of single elements, the setting up of five cell elements, and multiple cell elements. Matrix development, fabrication of the active anode layers, fabrication of the cathode layers, fabrication of graphite plates, assembly, and functioning of the cells were investigated. More than one hundred cell assemblies were built and tested between 1000 and 5000 hours of functioning. The multiple cell batteries prove to fail due to local overheating, uneven gas distribution, cracks in graphite plates, and obstruction of the hydrogen gas supply channels. The production technology of the matrix plates was optimized. The specific problem of the larger stacks is evaluated. Author (ESA)

**N83-11603#** Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
**AERODYNAMIC RESEARCH ON TIPVANE WIND TURBINES**
G. J. W. VANBRUSSEL, T. VANHOLTEN, and G. A. M. VANKUIK Apr. 1982 16 p refs
(VTH-LR-355) Avail: NTIS HC A02/MF A01

Aerodynamic loads on small auxiliary wings that are mounted at the tips of wind turbine blades in such a way that a diffuser effect is generated, resulting in a mass flow augmentation through the turbine disk, were analyzed. For load prediction, an expansion method, or lifting line approach, was used. The complete analytical expression for the pressure field consists of two series of basic pressure fields. One series is related to the basic load distributions over the turbine blade, and the other series to the basic load distribution over the tipvane. In addition, another basic pressure field, related to a triangular load distribution over the turbine blade and the tipvane, is needed in order to take care of the lift transfer from turbine blade to tipvane. The coefficients in these pressure field expressions are a priori unknown and are determined by a boundary condition, requiring the flow to be tangential on both turbine blade and tipvane. A numerical procedure then yields the coefficients of the basic pressure fields Author (ESA)

**N83-11607#** Energy Research Corp., Danbury, Conn
**INTERNAL REFORMING FOR NATURAL GAS FUELED MOLTEN CARBONATE FUEL CELLS Final Report, 1 May 1980 - 30 Jun. 1981**
B. BAKER, D. BURNS, C. LEE, H. MARU, and P. PATEL Dec. 1981 107 p Presented at the Natl. Fuel Cell Seminar, Norfolk, Va., Jun. 1981 and at the Intern. Gas Res. Conf., Los Angeles, Sep.-Oct. 1981 Sponsored by Gas Research Inst.
(PB82-200676, ERC-90-6194(13); GRI-80/0126) Avail: NTIS HC A06/MF A01 CSCL 10B

A natural gas fueled molten carbonate fuel cell (MCFC), a system which yields maximum efficiency while operating on internal reforming mode is discussed. Direct internal reforming appears to be a most promising configuration for internal reforming. Compared to the conventional baseline external reformer system, it can save as much as 20% natural gas at reduced capital and operating costs. Bench scale cells were operated with direct methane feed up to 2000 hours. It is shown that a successful development of the internal reforming MCFC will result in significant savings of natural gas and a cost effective electricity generation. GRA

**N83-12088*#** AiResearch Mfg. Co., Phoenix, Ariz.
**ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM DEVELOPMENT PROGRAM Monthly Technical Progress Report, 1 Aug. - 31 Aug. 1980**
R. A. RACKLEY 26 Sep. 1980 124 p
(Contract DEN3-167)
(NASA-CR-169475; NAS 1.26:169475; AMC-31-3480(11); MTPR-11) Avail. NTIS HC A06/MF A01 CSCL 21E

Gas turbine automobile powertrain research is reported. The compressor, turbine, combustor, regenerator, gearbox, ceramic components/subsystems, bearings, and controls are discussed.
N.W.

**N83-12327#** Fraser (J. Kenneth) and Associates, Rensselaer, N.Y.
**MODULAR SMALL HYDRO CONFIGURATION**
Sep. 1981 195 p refs
(PB82-184953; ERDA-81-16; REPT-262/ET-RER/80) Avail: NTIS HC A09/MF A01 CSCL 17B

Smaller sites (those under 750 kilowatts) which previously were not attractive to develop using equipment intended for application at larger scale sites, were the focal point in the conception of a system which utilizes standard industrial components which are generally available within short procurement times Such components were integrated into a development scheme for sites having 20 feet to 150 feet of head. The modular small hydro configuration maximizes the use of available components and minimizes modification of existing civil works. A key aspect of the development concept is the use of a vertical turbine multistage pump, used in the reverse mode as a hydraulic turbine. The configuration allows for automated operation and control of the hydroelectric facilities with sufficient flexibility for inclusion of potential hydroelectric sites into dispersed storage and generation (DSG) utility grid systems. GRA

**N83-12431*#** Detroit Diesel Allison, Indianapolis, Ind.
**ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS Semiannual Report, 1 Oct. 1979 - 30 Jun. 1980**
May 1981 285 p refs
(Contract DEN3-168)
(NASA-CR-165178; DOE/NASA/0168-80/1; NAS 1 26:165178, DDA-EDR-10327; SAR-1) Avail: NTIS HC A13/MF A01 CSCL 21E

Preliminary layouts were made for the exhaust system, air induction system, and battery installation. Points of interference were identified and resolved by altering either the vehicle or engine designs An engine general arrangement evolved to meet the vehicle engine compartment constraints while minimizing the duct pressure losses and the heat rejection. A power transfer system (between gasifier and power turbines) was developed to maintain nearly constant temperatures throughout the entire range of engine operation. An advanced four speed automatic transmission was selected to be used with the engine. Performance calculations show improvements in component efficiencies and an increase in fuel economy. A single stage centrifugal compressor design was completed and released for procurement. Gasifier turbine, power turbine, combustor, generator, secondary systems, materials, controls, and transmission development are reported Author

**N83-12437#** General Electric Co., Schenectady, N. Y.
**DEVELOPMENT OF HIGH TEMPERATURE TURBINE SUBSYSTEM TECHNOLOGY TO A TECHNOLOGY READINESS STATUS, PHASE 2 Quarterly Report, Jul. - Sep. 1981**
M. W. HORNER Oct. 1981 91 p refs
(Contract DE-AC01-76ET-10340)
(DE82-003222; DOE/ET-10340/119) Avail: NTIS HC A05/MF A01

A high temperature gas turbine for use in a combined cycle power plant, with coal derived fuel at a firing temperature of 26000 F and with growth capability to 30000 F was developed. Component design and technology testing in critical areas; and system design and tradeoff analyses in sufficient depth to support the component design and test tasks were performed; and the combined cycle plant studies to evaluate the commercial viability of a GE-TRV gas turbine system were updated. The turbine, combustor, hot gas cleanup system and other components were evaluated. DOE

**N83-12439#** R and D Associates, Marina Del Rey, Calif.
**CONCEPT EVALUATION OF AUTOMOTIVE PROPULSION USING LIQUID AIR/NITROGEN, TASK 5 REPORT**
J. L. DOOLEY and R. P HAMMOND Jul. 1982 12 p refs
(Contract DE82-01968; RDA-TR-118700-004)
Avail: NTIS HC A02/MF A01

Two alternative programs for developing a vehicle to demonstrate the performance of an automotive propulsion system using liquid air or nitrogen in a Rankine cycle engine are described. Program A is a two-stage development in which the initial stage is an examination in depth of the most critical areas of concept components without undertaking confirmatory hardware testing and development The second stage would continue the work with bench testing, complete component hardware development, and construction and testing of an instrumented roadable test vehicle and a demonstration vehicle Program B is a coordinated, interactive analysis, design and development course that results in a driveable demonstration vehicle in the shortest time and at the lowest cost It permits many low-cost bench tests to verify design early in the program. Operation of larger components can be done soon enough to get maximum feedback and interaction into the system design. The first two-stage program is justifiable and expedient in a period when adequate development funds are currently unavailable but may become available at a later date, while the alternative coordinated program is the more expeditious pathway to the goal of a successful demonstration of the concept DOE

**N83-12520#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
**ANALYTICAL MODE FOR INTERIM EXPANSION OF ELECTRICAL ENERGY GENERATING SYSTEMS M.S. Thesis [MODELO DE ANALISE DA EXPANSAO A MEDIO PRAZO DE SISTEMAS DE GERACAO DE ENERGIA ELETRICA]**
M. LAIDERA Oct. 1982 73 p refs IN PORTUGUESE; ENGLISH summary
(INPE-2558-TDL/104) Avail: NTIS HC A04/MF A01

Some planning aspects concerning to the expansion of Brasilian Electric Power System are presented. It is also presented a model with the aim of formulating and evaluating expansions plans for hydro-thermal generation system characterized by high amount of hydraulic generation, absence of reversible power plants and possibility of long distance energy transmission. Such model gives an expansion plan based upon the scheduling of expansion alternatives, which are classified by their cost/benefit rate, taking into account the influence of new additions on the present system B.W.

**N83-12522#** National Aerospace Lab., Tokyo (Japan).
**AN EXPERIMENTAL STUDY OF AN AERODYNAMICALLY OPTIMUM WINDMILL**
Y. ISHIDA, N. TODA, H HOSHINO, and M. NOGUCHI 1982 14 p refs In JAPANESE; ENGLISH summary
(NAL-TR-698; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Aerodynamic characteristics of an optimum horizontal axis windmill are described. The windmill, rated at 20 KW at 8 m/s with a two bladed rotor of 14m diameter, is designed so as to vary the geometry of the blade in such a way that the aerodynamic efficiency becomes maximum. The combined blade element momentum theory is used as an analytical tool. To check the design method and get some useful aerodynamic data, a wind tunnel test of a 1/7th scale model (2m diameter) is performed in a low speed tunnel, whose test section is 35.75 sq m. Two models, whose blades have the same optimum chord distribution but have different planforms, are tested. Measurements are made of the efficiency, torque, axial drag force and initial torque for various combinations of the pitch angle and the tip speed ratio. The yaw characteristics of the windmill are also measured. S.L.

**N83-12524*#** Westinghouse Electric Corp., Pittsburgh, Pa Advanced Energy Systems Div.
**CELL MODULE AND FUEL CONDITIONER DEVELOPMENT Quarterly Report, Jul. - Sep. 1981**
J M FERET Oct. 1981 33 p
(Contract DEN3-161, DE-AI01-80ET-17088)
(NASA-CR-165462-A; DOE/NASA/0161-9A; NAS 1.26:165462-A, XAL-72760-AL; QR-8) Avail: NTIS HC A03/MF A01 CSCL 10A

A phosphoric acid fuel cell (PAFC) stack design having a 10 kW power rating for operation at higher than atmospheric pressure based on the existing Mark II design configuration is described. Functional analysis, trade studies and thermodynamic cycle analysis for requirements definition and system operating parameter selection purposes were performed Fuel cell materials and components, and performance testing and evaluation of the repeating electrode components were characterized. The state of the art manufacturing technology for all fuel cell components and the fabrication of short stacks of various sites were established. A 10 kW PAFC stack design for higher pressure operation utilizing the top down systems engineering aproach was developed S.L

**N83-12526#** Von Karman Inst for Fluid Dynamics, Rhode-Saint-Genese (Belgium)
**WIND ENERGY CONVERSION DEVICES**
1981 381 p refs Lecture series held at Rhode-Saint-Genese, Belgium, 1-5 Jun 1981
(VKI-LS-1981-8) Avail: NTIS HC A17/MF A01

Wind energy conversion technology is discussed Wind turbines are considered. Rotor blades, computer programs, and energy storage are also considered

**N83-12527#** National Aerospace Lab, Amsterdam (Netherlands).
**GENERAL INTRODUCTION TO WIND ENERGY CONVERSION**
O. DEVRIES *In* Von Karman Inst for Fluid Dyn Wind Energy Conversion Devices 127 p 1981 refs
(NLR-MP-81014-U) Avail: NTIS HC A17/MF A01

Different wind turbine and wind concentrator concepts are surveyed The aerodynamic characteristics of wind turbines are discussed. The choice of the various parameters determining a WECS, such as wind data, turbine control, conversion system, structural, dynamic and cost aspcts and environmental impediments is surveyed. The design criteria and the desirability of formulating building codes for WECS are surveyed Author

**N83-12528#** IIT Research Inst., Chicago, Ill
**SITE CHARACTERISTICS FOR WIND ENERGY CONVERSION DEVICES**
R. S. NORMAN *In* Von Karman Inst for Fluid Dyn. Wind Energy Conversion Devices 20 p 1981 refs
Avail: NTIS HC A17/MF A01

The importance of wind characteristics and topography in placing a wind energy system are discussed. N W.

**N83-12529#** Illinois Inst of Tech, Chicago
**HORIZONTAL AND VERTICAL AXIS WIND TURBINES**
R. S. NORMAN *In* Von Karman Inst. for Fluid Dyn. Wind Energy Conversion Devices 20 p 1981 refs
Avail: NTIS HC A17/MF A01

Horizontal axis wind turbines are discussed. Vertical axis wind turbines are also discussed. Blade configurations are reviewed. N W

**N83-12530#** Saab-Scania, Linkoping (Sweden).
**AERODYNAMIC ANALYSIS OF HORIZONTAL AXIS WIND TURBINES**
O. A. M. HOLME *In* Von Karman Inst. for Fluid Dyn Wind Energy Conversion Devices 40 p 1981
Avail: NTIS HC A17/MF A01

Axial momentum theory, vortex theory and inviscid flow, viscous flow and aerodynamic loads, derivatives of the aerodynamic load, maximum tip speed ratio, turbine design for maximum power, optimization, and turbines in rotationally unsymmetric flow are discussed. N.W.

**N83-12531#** Wichita State Univ., Kans. Wind Energy Lab.
**AIRFOIL DATA FOR WIND TURBINES**
M. H. SNYDER *In* Von Karman Inst. for Fluid Dyn. Wind Energy Conversion Devices 18 p 1981 refs
Avail. NTIS HC A17/MF A01

Some of the problems encountered by wind turbine designers in applying aerodynamic characteristics of airfoil sections to design of wind energy conversion systems are reviewed. It is necessary to know airfoil characteristics over a wider range of Reynolds numbers and angles of attack than is necessary for aircraft applications Some of the studies of the effects of changing airfoils on wind turbine performance are also reviewed Author

**N83-12532#** Wichita State Univ., Kans. Wind Energy Lab
**CONTROL SYSTEMS FOR HORIZONTAL-AXIS WIND TURBINES**
M H. SNYDER *In* Von Karm Inst. for Fluid Dyn. Wind Energy Conversion Devices 20 p 1981 refs
Avail: NTIS HC A17/MF A01

Control requirements for wind turbine systems and problems of conventional controls are discussed. Alternates to pitch control for large horizontal-axis wind turbines are changing pitch of blade tips or use of ailerons or spoilers. Studies was conducted to determine feasibility of using such control systems on the NASA MOD-O machine. Results show that either ailerons or spoilers can provide control necessary to limit turbine power in high wind conditions. An aileron system is recommended for the present application, based upon the ability of ailerons to provide self-starting and added power at low wind speed conditions. The preliminary design study including aileron component sizing and maximum hinge moments was completed and ailerons were fabricated for testing on the MOD-O turbine Author

**N83-12534#** Wichita State Univ., Kans. Wind Energy Lab
**USERS MANUAL FOR WIND**
M H SNYDER *In* Von Karman Inst. for Fluid Dyn. Wind Energy Conversion Devices 26 p 1981 refs
Avail: NTIS HC A17/MF A01

Information is provided to assist users working with WIND, a program designed to calculate the performance of a wind-axis turbine Author

**N83-12535#** Stuttgart Univ. (West Germany). Institute fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen
**STATIC AND DYNAMIC ANALYSIS FOR HINGED ROTOR BLADES OF 60 M SPAN FOR A TWO BLADED HORIZONTAL AXIS WIND ENERGY CONVERTER**
J. H. ARGYRIS, K. A. BRAUN, and B. KIRCHGAESSNER *In* Von Karman Inst. for Fluid Dyn. Wind Energy Conversion Devices 51 p 1981 refs
Avail NTIS HC A17/MF A01

The static and dynamic behavior of a rotor blade of a horizontal axis wind energy converter with flap- and lag-hinges and with coupling of flap and pitch is investigated. Under the assumption of rigid support of the hub and of constant rotational speed, the linearized equations of motion are developed using a finite element idealization considering quasi-steady aerodynamic forces. The complex eigenfrequencies are calculated. The time history response of the rotor blade is computed for cyclic gravitational loads at rated operation and for a global gust. From the deformation of the structure the stresses at selected points along the blade and forces and moments acting on the tower are calculated Author

**N83-12537#** Honeywell Power Sources Center, Horsham, Pa.
**HIGH EFFICIENCY LITHIUM-THIONYL CHLORIDE CELL Final Research and Development Technical Report, 10 Apr. 1981 - 9 May 1982**
N. DODDAPANENI Aug. 1982 97 p refs
(Contract DAAK20-81-C-0381; DA PROJ. 1L1-62705-AH-94)
(AD-A118696; DELET-TR-81-0381-F) Avail: NTIS HC A05/MF A01 CSCL 10C

The polarization characteristics and the specific cathode capacity of Teflon bonded carbon electrodes in the Li/SOCl2 system have been evaluated Doping of electrocatalysts such as cobalt and iron phthalocyanine complexes improved both cell voltage and cell rate capability. High efficiency Li/SOCl2 cells were thus achieved with catalyzed cathodes The electrochemical reduction of SOCl2 seems to undergo modification at catalyzed cathode. For example, the reduction of SOCl2 at FePc catalyzed cathode involves 2-1/2 e-/mole of SOCl2. Furthermore, the reduction mechanism is simplified and unwanted chemical species are eliminated by the catalyst. Thus a potentially safer high efficiency Li/SOCl2 can be anticipated. GRA

**N83-12564#** Agricultural Research Service, Manhattan, Kans. Wind Erosion Research Unit.
**DARRIEUS WIND-TURBINE AND PUMP PERFORMANCE FOR LOW-LIFT IRRIGATION PUMPING Final Report**
L. J. HAGEN and M. SHARIF Oct. 1981 65 p refs Prepared in cooperation with Kansas State Univ., Manhattan
(Contract DE-AI01-76ET-20319)
(DE82-016270; CONTRIB-79-435-D; DOE/ARS-3707-20741/81-1) Avail: NTIS HC A04/MF A01

In the Great Plains about 15 percent of the irrigation water pumped on farms comes from surface water sources, for the United States as a whole, the figure is about 22 percent. Because of forecast fuel shortages, there is a need to develop alternative energy sources such as wind power for surface water pumping. Specific objectives of this investigation were to: design and assemble a prototype wind powered pumping system for low lift irrigation pumping, determine performance of the prototype system; design and test an irrigation system using the wind powered prototype in a design and test an farm application; and determine the size combinations of wind turbines, tailwater pits, and temporary storage reservoirs needed for successful farm application of wind powered tailwater pumping systems in western Kansas. The power source selected was a two bladed, 6 m diameter, 9 m tall Darrieus vertical axis wind turbine with 0.10 solidity and 36.1 M(2) swept area. DOE

**N83-12565#** Wynholds (Hans W) Co., Cupertino, Calif.
**SAFETY DATA FOR SMALL WIND SYSTEMS**
L. BASS, H. WYNHOLDS, J. BLOEDORN, P. WEIS, and F. HERZOG Sep 1981 111 p refs Prepared for Rockwell International Corp., Golden, Colo.
(Contract DE-AC04-76DP-03533)
(DE82-015400; RFP-3305) Avail: NTIS HC A06/MF A01

Technical data and recommediations in the development of small wind energy conversion systems (SWECS) safety standards are provided. A SWECS hazards analysis was prepared using system safety techniques. Hazards are identified, standards are proposed, and other appropriate actions are recommended to reduce to the risk of personal injury or property DOE

**N83-12592#** Texas A&M Univ, College Station. Dept. of Chemical Engineering.
**METAL CHELATE CATALYSTS FOR FUEL CELLS Annual Report**
R. DARBY, R. WHITE, M. YAMANA, and M. TSUTSUE Jul. 1981 34 p
(Contract GRI-5014-363-0174)
(PB82-195637; GRI-81/0027) Avail: NTIS HC A03/MF A01 CSCL 10B

A variety of metal chelates were synthesized and evaluated for their activity as oxygen cathode electrocatalysts in strong acidic electrolytes. It was found that Cobalt tetraazaanulene (CoTAA) and iron phthalocyanine (FePc) exhibit the best activity of all the metal chelates synthesized, but have very limited stability. The proposed solution to this problem is the synthesis of polymeric forms of these chelates, with comparable active and considerably greater stability than the monomers. Three methods for stability testing were developed: (1) Potentiostatic, with periodic measurement of the current potential characteristic; (2) potentiostatic, with continuous monitoring of the current, and; (3) galvanostatic, with continuous monitoring of potential. Each method provides a good evaluation of activity versus time, and the method to be used depends upon the objective of the test. A polymeric form of Co(TAA) was synthesized by means of an acetylene terminated monomer, which in turn was made via a Co(TAA)Br2 intermediate. The activity of the polymer was found to be comparable to that of Co(TAA) monomer, and significantly greater than that of either the stacked or sheet polymeric forms of Cobalt tetraphenylporphrine (CoTPP) previously synthesized and tested.
Author (GRA)

**N83-12995#** Nagoya Univ. (Japan). Inst. of Plasma Physics.
**ANALYSIS OF STABILIZATION EFFECT OF QUADRUPOLE FIELD ON THETA PINCH PLASMAS**
T. ISHIMURA (Osaka Univ., Japan) Aug. 1982 7 p refs
(IPPJ-608) Avail NTIS HC A02/MF A01

A stability analysis based on MHD approximation was done on the effect of quadrupole field to suppress the n = 2 rotational instability occurring in theta pinch plasmas. Applying the analysis to the results of the experiment on the suppression of the instability, the theoretical threshold of B sub S becomes as 0.05 T, while the experimental one is 0.06 T. S.L.

**N83-12996#** Nagoya Univ (Japan). Inst. of Plasma Physics.
**SUFFICIENT STABILITY CONDITION FOR ALPHA-DRIVEN VELOCITY-SPACE MODES IN COMPRESSION TOKAMAK**
K. YAMAZAKI and M. OKAMOTO Sep. 1982 24 p refs
(IPPJ-609) Avail: NTIS HC A02/MF A01

The conditions for isotropic velocity space stability in compression Tokamaks and the possibility of thermonuclear instabilities were examined. Magnetic compression heating may invert the velocity distribution of alpha particles, which leads to velocity-space instabilities. A sufficient stability conditon is derived for these modes in compression Tokamaks. High field high density compression scenarios like Zephyr satisfy the stability condition, while medium field high temperature compression scheme like FTR may cause exciting velocity space thermonuclear instabilities.
E.A.K.

**N83-12997#** Nagoya Univ. (Japan). Inst. of Plasma Physics
**COMMENTS ON THERMAL RUNAWAY EXPERIMENTS IN SUB-IGNITION TOKAMAKS**
K. YAMAZAKI Sep. 1982 15 p refs
(IPPJ-610) Avail: NTIS HC A02/MF A01

The rough conditions for thermal runaway due to alpha particle heating to justify deuterium-tritium (D-T) operation of medium sized Tokamaks are examined. Justification of D-T operations from the physics viewpoint is discussed. Optimal thermal runaway experiments in high field, high density compact Tokamaks are suggested within the minimization of the induced radioactivation.
E.A.K.

**N83-12998*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**ANISOTROPY IN MHD TURBULENCE DUE TO A MEAN MAGNETIC FIELD**
J. V. SHEBALIN, W. H. MATTHAEUS, and D. MONTGOMERY Sep 1982 43 p refs
(NASA-TM-84000; NAS 1.15:84000) Avail: NTIS HC A03/MF A01 CSCL 20I

The development of anisotropy in an initially isotropic spectrum is studied numerically for two-dimensional magnetohydrodynamic turbulence The anisotropy develops due to the combined effects of an externally imposed dc magnetic field and viscous and resistive dissipation at high wave numbers. The effect is most pronounced

at high mechanical and magnetic Reynolds numbers. The anisotropy is greater at the higher wave numbers. Author

**N83-13001#** California Univ., Livermore. Lawrence Livermore Lab.
**PLASMA PARAMETER MEASUREMENTS USING NEUTRAL-PARTICLE-BEAM ATTENUATION**
J. H FOOTE, A. W. MOLVIK, and W. C. TURNER 7 Jul. 1982 48 p refs
(Contract W-7405-ENG-48)
(DE82-021120; UCID-19422) Avail: NTIS HC A03/MF A01

Intense and energetic neutral particle beam injection used for fueling or heating magnetically confined, controlled fusion experimental plasmas which make diagnostic measurements of the plasmas are discussed. The attenuation of an atomic beam when passing through a plasma gives the plasma line density. Orthogonal arrays of highly collimated detectors of the secondary electron emission type are used in magnetic mirror experiments to measure neutral beam attenuation along chords through the plasma volume at different radial and axial positions The radial array is used to infer the radial plasma density profile; the axial array, to infer the axial plasma density profile and the ion angular distribution at the plasma midplane. DOE

**N83-13003#** Science Applications, Inc , Boulder, Colo. Plasma Research Inst.
**REDUCTION OF NEOCLASSICAL LOSSES IN MAGNETIC-CONFINEMENT DEVICES**
J. R. MYRA, D. A. DIPPOLITO, and P J. CATTO Jul. 1982 12 p refs
(Contract DE-AC03-76ET-53057)
(DE82-020277; SAI-254-82-219-LJ; PRI-46) Avail: NTIS HC A02/MF A01

Transport and direct radial losses result from the departure of particle drift surfaces from magnetic flux (constant pressure) surfaces In order for a device to have the most favorable neoclassical particle confinement, it is desirable that the drift and flux surfaces remain as close as possible everywhere along the magnetic field. A technique is presented which minimizes this departure by the appropriate modification of the magnetic field geometry. The method is illustrated by determining the optimized fanning for specified mirror magnetic field profiles. DOE

**N83-13006#** Oak Ridge National Lab , Tenn. Fusion Energy Div.
**COMPUTATIONAL METHODS IN TOKAMAK TRANSPORT**
W. A. HOULBERG, S. E. ATTENBERGER, and L. L. LAO Jun. 1982 36 p refs
(Contract W-7405-ENG-26)
(DE82-016616) Avail: NTIS HC A03/MF A01

A variety of numerical methods for solving the time dependent fluid transport equations for Tokamak plasmas is presented Among the problems discussed are techniques for solving the sometimes very stiff parabolic equations for particle and energy flow, treating convection-dominated energy transport that leads to large cell Reynolds numbers, optimizing the flow of a code to reduce the time spent updating the particle and energy source terms, coupling the one dimensional flux-surface-averaged fluid transport equations to solutions of the 2-D Grad-Shafranov equation for the plasma geometry, handling extremely fast transient problems such as internal MHD disruptions and pellet injection, and processing the output to summarize the physics parameters over the potential operating regime for reactors Emphasis is placed on computational efficiency in both computer time and storage requirements. DOE

**N83-13007#** Massachusetts Inst of Tech., Cambridge. Plasma Fusion Center.
**LOWER-HYBRID-HEATING EXPERIMENTS ON THE ALCATOR C AND THE VERSATOR II TOKAMAKS**
M. PORKOLAB, J. J. SCHUSS, Y. TAKASE, S. TEXTER, C. L. FIORE, R. GANDY, M J. GREENWALD, D. A. GWINN, B. LIPSCHULTZ, E. S. MARMAR et al 1982 15 p refs Presented at the 3rd Intern. Symp. on Heating in Toroidal Devices, Grenoble, France, 22 Mar 1982
(Contract DE-AC02-78ET-51013)
(DE82-013674; DOE/ET-51013/41; PFC/CP-82-5; CONF-820345-10) Avail: NTIS HC A02/MF A01

Initial results from lower hybrid wave heating experiments carried out on the MIT Alcator-C and Versator II Tokamak are reported In the Alcator-C experiments a 4 waveguide array, with internally brazed ceramic windows was used to inject 160 kW of microwave power at 4.6 GHz into the plasma with nO less than or equal to 1 x 10(15) cm(+3), and BO less than or equal to 12 T. The RF coupling studies show optimal coupling when the local density at the waveguide mouth is 25 to 50 times overdense. Heating experiments show an ion tail formation in hydrogen discharge peaking at a density of anti-n approx. = 2.7 x 10(14) cm(+3) at B = 8 9 T, and bulk ion heating at a density of anti n approx. = 1.5 x 10(14) c(+3) at B approx. = 11 T. Evidence of RF current enhancement has been observed at a density of n approx. = 3 x 10(13) cm (+3) Doppler broadening of the OVII and NVI lines shows a (RADICAL)T/sub i/= 50 eV rise in the bulk ion temperature A significant RF produced ion tail is also observed by charge exchange analysis. A toroidal ray tracing code and a 1-D transport code to study the heating density bands and heating efficiencies were successfully combined. DOE

**N83-13008#** Sandia Labs., Albuquerque, N. Mex. Fusion Energy Div
**FUSION ENERGY DIVISION AUTOMATION OF THE ISX-B NEUTRAL BEAMS**
S. C BATES and P. C HANNA Jun 1982 21 p refs
(Contract W-7405-ENG-26)
(DE82-016369; ORNL/TM-8279) Avail: NTIS HC A02/MF A01

Operation of the two neutral beams on the ISX-B Tokamak was fully automated for an injected power up to 2 MW. A PDP 11/34 FORTRAN program conditions and injects the beams using commercial CAMAC hardware and ad hoc modifications of the beam controls. The fundamental beam conditioning algorithm is based on the breakdown history of the source. Difficulties encountered were noise entering the CAMAC through control and data lines and the lack of well-defined operating heuristics detailed problem diagnostic techniques. A brief description is given of the hardware and software systems, operating techniques, and items of special concern. DOE

**N83-13038*#** Garrett Turbine Engine Co., Phoenix, Ariz.
**ADVANCED GAS TURBINE (AGT) POWERTRAIN SYSTEM DEVELOPMENT FOR AUTOMOTIVE APPLICATIONS**
**Semiannual Progress Report, Jul. - Dec. 1980**
Jul. 1981 151 p refs
(Contract DEN3-167)
(NASA-CR-165329, DOE/NASA-0167-81-2; NAS 1.26:165329, GTEC-31-3725(2); SAPR-2) Avail: NTIS HC A08/MF A01
CSCL 13F

An automotive gas turbine powertrain system which, when installed in a 1985 production vehicle (3000 pounds inertia weight), is being developed with a CFDC fuel economy of 42.8 miles per gallon based on Environmental Protection Agency (EPA) test procedures and diesel No 2 fuel. The AGT-powered vehicle shall give substantially the same overall vehicle driveability and performance as a comparable 1985 production vehicle powered by a conventional spark ignition powertrain system (baseline system). Gaseous emissions and particulate levels less than: NOx = 0.4 gm/mile, HC = 0.41 gm/mile, and CO = 3 4 gm/mile, and a total particulate of 0 2 gm/mile, using the same fuel as used for fuel economy measurements is expected, along with the ability to use a variety of alternate fuels. S.L. q

**N83-13359*#** Pittsburgh Univ.,
**LOSSES IN CHOPPER-CONTROLLED DC SERIES MOTORS Final Report**
H. B. HAMILTON Apr. 1982 127 p refs
(Contract NSG-3163, DE-AI01-77CS-51044)
(NASA-CR-167845; DOE/NASA-3163-1; NAS 1.26:167845)
Avail: NTIS HC A07/MF A01 CSCL 09C

Motors for electric vehicle (EV) applications must have different features than dc motors designed for industrial applications. The EV motor application is characterized by the following requirements. (1) the need for highest possible efficiency from light load to overload, for maximum EV range, (2) large short time overload capability (The ratio of peak to average power varies from 5/1 in heavy city traffic to 3/1 in suburban driving situations) and (3) operation from power supply voltage levels of 84 to 144 volts (probably 120 volts maximum). A test facility utilizing a dc generator as a substitute for a battery pack was designed and utilized. Criteria for the design of such a facility are presented. Two motors, differing in design detail, commercially available for EV use were tested Losses measured are discussed, as are waves forms and their harmonic content, the measurements of resistance and inductance, EV motor/chopper application criteria, and motor design considerations S.L.

**N83-13372#** Chalmers Univ of Technology, Goteborg (Sweden). Dept of Electrical Machinery
**SOME METHODS TO CONNECT A WINDPOWER INDUCTION GENERATOR TO THE UTILITY NETWORK**
O. CARLSSON and J HYLANDER Apr. 1981 6 p refs
(DE82-750057; NE/VIND-81/4) Avail NTIS (US Sales Only) HC A02/MF A01, DOE Depository Libraries

When an induction generator is switched on to a grid, heavy inrush currents may appear, which may result in a transient voltage variation. By using inductors or thyristors in series with the generator, or capacitor excitation before synchronizing it, the inrush currents could be limited to acceptable levels. DOE

**N83-13589*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**METHODS OF REDUCING ENERGY CONSUMPTION OF THE OXIDANT SUPPLY SYSTEM FOR MHD/STEAM POWER PLANTS**
A. J. JUHASZ 1983 15 p Proposed for presentation at the 21st Aerospace Sci. Meeting, Reno, Nev., 10-13 Jan. 1983; sponsored by AIAA
(Contract DE-AI01-77ET-10769)
(NASA-TM-83025; DOE/NASA/10769-28; E-1461; NAS 1.15:83025) Avail: NTIS HC A02/MF A01 CSCL 10B

An in-depth study was conducted to identify possible improvements to the oxidant supply system for combined cycle MHD power plants which would lead to higher thermal efficiency and reduction in the cost of electricity, COE. Results showed that the oxidant system energy consumption could be minimized when the process was designed to deliver a product O2 concentration of 70 mole percent. The study also led to the development of a new air separation process, referred to as liquid pumping and internal compression. MHD system performance calculations show that the new process would permit an increase in plant thermal efficiency of 0.6 percent while allowing more favorable tradeoffs between magnetic energy and oxidant system capacity requirements. Author

**N83-13608#** Naemnden foer Energiproduktionsforskning, Stockholm (Sweden).
**INTERACTION IN LIMITED ARRAYS OF WINDMILLS**
C. CRAFOORD Mar. 1979 54 p refs
(DE82-750056, NE/VIND-80/39) Avail: NTIS (US Sales Only) HC A04/MF A01; DOE Depository Libraries

The problem of how closely packed an array of windmills can be erected without unduly interfering with each other was investigated. Earlier results for neutral stratification are presented in a slightly different manner, more fully illustrating the tradeoff between windmill density and mean efficiency as function of group size. A variation in mean efficiency of 13% for a group with 80 units, which may correspond to a factor of 2.5 in area coverage is indicated. A dynamic one dimensional planetary boundary layer (PBL) model is presented and redesigned for simulation experiments. The regeneration of the wind profiles behind a windmill unit is studied for different ambient conditions. A variation of up to a factor of 9 in the rate of regeneration of the profiles was found. The use of a statistical approach with lateral homogenization of the wind profiles is discussed. DOE

**N83-13625#** Sandia Labs., Albuquerque, N Mex
**FORCED VIBRATION ANALYSIS OF ROTATING STRUCTURES WITH APPLICATION TO VERTICAL AXIS WIND TURBINES**
D. W. LOBITZ 1981 22 p refs Presented at the 5th Biennial Wind Energy Conf. and Workshop, Washington, D C., 5 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-000620; SAND-81-2141C; CONF-811043-1) Avail: NTIS HC A02/MF A01

Predictive methods for the dynamic analysis of wind turbine systems are important for assessing overall structural integrity and fatigue life. For the former, the identification of resonance points (spectral analysis) is of primary concern. For the latter forced vibration analysis is necessary. These analyses are complicated by the fact that, for a spinning turbine, the stress-producing deformations take place in both fixed and rotating reference systems simultaneously. As an example, the tower of a horizontal axis wind turbine (HAWT) must be analyzed in a fixed frame, and the rotor in a rotating one. Forced vibration analysis is further complicated in that accurate models need to be developed for aeroload prediction. Methods which are available for forced vibration analysis of both horizontal and vertical axis machines are identified and the method which was developed for vertical axis wind turbines is emphasized, with some comparisons of the predictions to experimental data. DOE

**N83-13633#** Gamze-Korobkin-Caloger, Inc., Chicago, Ill.
**THE 40KW FUEL CELL FIELD TEST SUPPORT Final Report, Mar. 1980 - May 1981**
J A. ORLANDO and M. G. GAMZE Feb. 1982 66 p refs
(Contract GRI-5041-344-0192)
(PB82-231630; GRI-80/0101) Avail: NTIS HC A04/MF A01 CSCL 10B

GRI and the gas utilities are supporting a field test as one step forward in the commercialization of fuel cells Broad programmatic oriented activities conducted by GKC include: preparation and presentation of a seminar on guidelines for use by individual utilities, first in the screening of candidate sites and then for use in the design of the fuel cell site mechanical and electrical interfaces; performance of an error analysis for site instrumentation; and participation in the GRI/utility review of the UTC development of a fuel cell Add-On Package which will allow gnd connected 40 kW units. GKC also provided consulting support to individual utilities. Author (GRA)

**N83-13714#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
**WIND-ENERGY PROGRAM: FY 1982 THIRD QUARTERLY REVIEW**
R. MITCHELL, R. J. NOUN, T. FLAIM, M. DEUTSCH, S. HOCK, H. SKLAR, and N. D. KELLEY Aug. 1982 33 p refs
(Contract DE-AC02-77CH-00178; EG-77-C-01-4042)
(DE82-019928; SERI/PR-211-1672) Avail: NTIS HC A03/MF A01

The objective, accomplishments, planned activities, output, and subcontracts are briefly summarized for each of the following tasks of the Wind Energy Program: program management and planning, wind energy conversion systems (WECS) application in nongenerating utilities, technical feasibility of stand-alone small WECS (SWECS), WECS performance/value analysis, wind energy industry analysis, wind systems coordination, wind workshops, noise and television interference studies, and advanced and innovative wind energy concepts. Each task summary includes a milestone

chart. Also given are lists of research and development subcontracted projects for FY 1981 and FY 1982, principal subcontractors for FY 1982 projects, and current Wind Energy Program publications DOE

**N83-13974#** Department of Energy, Washington, D. C.
**SPECIAL-PURPOSE MATERIALS FOR MAGNETICALLY CONFINED FUSION REACTORS Annual Progress Report**
J. L. SCOTT, comp. Nov. 1981 114 p
(DE82-005310; DOE/ER-0113; APR-3) Avail: NTIS HC A06/MF A01

Fusion reactor materials problems other than the first-wall and blanket structural materials are discussed. Components that are considered as special purpose materials include breeding materials, coolants, neutron multipliers, barriers for tritium control, materials for compression and OH coils and waveguides, graphite and SiC, heat-sink materials, ceramics, and materials for high-field superconducting magnets. DOE

**N83-13989#** Nagoya Univ. (Japan). Inst. of Plasma Physics.
**ANALYSIS OF TARGET IMPLOSION IRRADIATED BY PROTON BEAM. 1: BEAM INTERACTION WITH TARGET PLASMA**
M. TAMBA (Inst. of Physical and Chemical Research, Saitama, Japan), N. NAGATA (Tokyo Inst. of Technology, Yokohama, Japan), S. KAWATA (Tokyo Inst. of Technology, Yokohama, Japan), and K NIU (Tokyo Inst. of Technology, Yokohama, Japan) Oct. 1982 54 p refs
(IPPJ-612) Avail: NTIS HC A04/MF A01

Numerical simulations and analyses are given for the implosion of a hollow shell target driven by proton beams. The target consists of layers of Pb, Al, and DT. The Pb and Al layers play roles of a tamper and a pusher, respectively. The main part of the beam energy is deposited in the Al layer. But the process of deposition depends much on the distribution of incident angles and particle energies. As the Al layer is heated by proton beams, the layer expands and pushes the DT layer toward the target center. This kind of implosion motion is examined by using a similar solution for the slab model. The effect of inhomogeneities on implosion is shown to be severe. The fluctuation of temperature in the Al layer must be less than 10% and the deviation of the pusher thickness from the average should be less than microns to keep a high target gain. Author

**N83-13990#** Nagoya Univ. (Japan). Inst. of Plasma Physics.
**NON-CIRCULAR BUMPY TORUS**
A. TSUSHIMA, H. TSUCHIDATE, T. KAMIMURA, M. FUJIWARA, and H. IKEGAMI Jul 1982 35 p refs
(IPPJ-607) Avail: NTIS HC A03/MF A01

A bumpy torus with noncircular coils is studied analytically and numerically with respect to the confinement of high energy passing particles. The minimum position r sub Jmin of the longitudinal invariant J, and the confinement area sP for passing particles ($V^*/V = 1$) are calculated for the evaluation of confinement performance As one example of noncircular bumpy tori, the inverse dee bumpy torus is found to be much superior to a circular one with the same aspect ratio when its value is large enough (A approx. 20). M.G.

**N83-13993#** Sandia Labs., Albuquerque, N Mex.
**BEAM AND DEPOSITION STABILITY IN LIGHT-ION FUSION TARGETS**
J. A. SWEGLE Mar. 1982 64 p refs
(Contract DE-AC04-76DP-00789)
(DE82-017768; SAND-82-0072) Avail: NTIS HC A04/MF A01

The plasma stability of beam target and deposition processes in parameter regimes appropriate to light ion driven inertial confinement fusion targets were reviewed. Electrostatic and electromagnetic streaming instabilities driven by a charge and current neutralized ion beam are emphasized. It is assumed that the beam is collisionless and that the target medium is homogeneous and infinite in extent. The two thermal instabilites which are discussed are: a potentially unstable interaction involving ion beam range shortening as the target temperature increases, and fluid condensation instability. It is found that the range shortening interaction are a stable process. DOE

**N83-13994#** Oak Ridge National Lab , Tenn.
**FUSION RESEARCH AT ORNL**
Mar. 1982 89 p refs
(Contract W-7405-ENG-26)
(DE82-017766; ORNL/TM-8316) Avail: NTIS HC A05/MF A01

The ORNL fusion program which includes the experimental and theoretical study of two different classes of magnetic confinement schemes is outlined. The study includes. systems with helical magnetic fields, such as the Tokamak and stellarator, and the ELMO Bumpy Torus (EBT) class of toroidally linked mirror systems; the development of technologies, including superconducting magnets, neutral atomic beam and radio frequency (rf) heating systems, fueling systems, materials, and diagnostics; the development of the environment impact of magnetic fusion; and the design of advanced demonstration fusion devices. DOE

**N83-13996#** Los Alamos Scientific Lab., N. Mex
**EQUILIBRIUM POLOIDAL FIELD DISTRIBUTIONS IN REVERSED-FIELD-PINCH TOROIDAL DISCHARGES**
D A. BAKER, L. W. MANN, and K F. SCHOENBERG Apr. 1982 38 p refs
(Contract W-7405-ENG-36)
(DE82-014130; LA-9L62-MS) Avail: NTIS HC A03/MF A01

A comparison between the analytic formulae of Shafranov for equilibrium in axisymmetric toroidal reversed field pinch (RFP) systems and fully toroidal numerical solutions of the Grad-Shafranov equation is presented as a function of poloidal beta, internal plasma inductance, and aspect ratio. The Shafranov formula for the equilibrium poloidal field distribution is accurate to within 5% for aspect ratios greater than 2, poloidal betas less than 50%, and for plasma current channels that exceed one-third of the minor toroidal radius. The analytic description for the center shift of the innermost flux surface that encloses the plasma current (the Shafranov shift) is accurate to within 15% for aspect ratios greater than 2 and poloidal betas below 50%, provided the shift does not exceed one-tenth of the minor conducting boundary radius. The behavior of the magnetic axis shift as a function of plasma parameters is included. The Shafranov formulae provide a convenient method for describing the equilibrium behavior of an RFP discharge. Examples illustrating the application of the analytic formulae to the Los Alamos ZT-40M RFP experiment are given DOE

**N83-13997#** California Univ., Livermore. Lawrence Livermore Lab.
**FEASIBILITY STUDY OF A FISSION-SUPPRESSED TANDEM-MIRROR HYBRID REACTOR**
J. D. LEE, R. W. MOIR, and W. L. BARR Apr. 1982 813 p refs
(Contract W-7405-ENG-48)
(DE82-019375; UCID-19327) Avail. NTIS HC A99/MF A01

Results of a conceptual design study of a U-233 producing fusion breeder consisting of a tandem mirror fusion device and two types of fission suppressed blankets are presented. The majority of the effort was devoted to the conceptual design and evaluation of the two blankets. However, studies in the areas of fusion engineering, reactor safety, fuel reprocessing, other fuel cycle issues, economics, and deployment were also performed DOE

**N83-13998#** Wisconsin Univ., Madison.
**POLOIDAL OHMIC HEATING IN A MULTIPOLE**
D. J HOLLY, S. C. PRAGER, and J. C. SPROTT Jul. 1982 22 p refs
(Contract DE-AC02-76ET-53051)
(DE82-019888, DOE/ET-53051/42) Avail: NTIS HC A02/MF A01

The feasibility of using poloidal currents to heat plasmas confined by a multipole field was examined experimentally in Tokapole 2, operating the machine as a toroidal octupole The

plasma resistivity ranges from Spitzer to about 1500 times Spitzer resistivity, as predicted by mirror-enhanced resistivity theory. This allows large powers (approx. 2 MW) to be coupled to the plasma at modest current levels. However, the confinement time is reduced by the heating, apparently due to a combination of the input power location (near the walls of the vacuum tank) and fluctuation-enhanced transport. Current-driven drift instabilities and resistive MHD instabilities appear to be the most likely causes for the fluctuations. DOE

**N83-13999#** Oak Ridge National Lab., Tenn.
**ORNL INTEGRAL EXPERIMENT TO PROVIDE DATA FOR EVALUATING MAGNETIC-FUSION-ENERGY SHIELDING CONCEPTS. PART 1: ATTENUATION MESUREMENTS**
G. T. CHAPMAN, G. L. MORGAN, and J. W. MCCONNELL Aug. 1982 156 p refs
(Contract W-7405-ENG-26)
(DE82-019775; ORNL/TM-7356-PT-1) Avail: NTIS HC A08/MF A01

Integral experiments to measure the energy spectra of neutrons and gamma rays due to the transport of approximately 14 MeV T(d,n) (4)He neutrons through laminated stainless steel and borated polyethylene shield configurations were performed at the Oak Ridge National Laboratory. An NE 213 detector and conventional pulse shape discrimination circuitry were used to record the pulse height distributions from which the energy spectra were derived. Descriptions of the facility and experimental techniques are given along with tables and curves showing the results of the measurements. DOE

**N83-14000#** Science Applications, Inc., Boulder, Colo. Plasma Research Inst.
**RADIAL GUIDING-CENTER DRIFTS AND OMNIGENITY IN BUMPY-TORUS CONFINEMENT SYSTEMS**
R. D. HAZELTINE and P. J CATTO Jul. 1982 27 p refs
(DE82-019802; SAI-254-82-200-LJ; PRI-45) Avail: NTIS HC A03/MF A01

Collisional transport of a high temperature plasma across the confining field of a bumpy torus magnetic confinement system which depends sensitively upon the functional form of the radial quiding center drift, and thus upon details of the confinement geometry is discussed. A general and relatively explicit formula for the radial drift is derived, using the large aspect-ratio results of a previous equilibrium study. Allowance is made for: (1) arbitrary toroidal variation of the confining field; (2) field distortion due to plasma currents; (3) noncircular deformation of the toroidal field coils. The analysis pertains only to the plasma core, and not to the high beta annuli (electron rings) which are usually present in experiments. The question of bumpy torus omnigenity whether any bumpy torus field configuration is consistent with a vanishing, or nearly vanishing, radial drift, is also investigated. It is found that omnigenity does not occur in the vicinity of the magnetic axis. DOE

**N83-14151#** State Univ. of New York at Buffalo, Amherst.
**INVESTIGATION OF POWER PROCESSING TECHNOLOGY FOR SPACECRAFT APPLICATIONS Final Report, 1 May 1981 - 31 Mar. 1982**
A. S. GILMOUR, JR. Jun. 1982 35 p refs
(Contract F33615-81-C-2011; AF PROJ. 3145)
(AD-A119644; AFWAL-TR-82-2054) Avail: NTIS HC A03/MF A01 CSCL 10C

This report summarizes an investigation of power processing technology applicable to future satellite electrical power systems. The issues of AC vs DC distribution are addressed as is the optimum distribution voltage. DC distribution is recommended. Distributions voltage should be as high as practical but less than 270 volts. Author (GRA)

**N83-14156#** R and D Associates, Arlington, Va.
**RESEARCH NEEDS: PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS Final Report, 26 Oct. 1981 - 31 Jul. 1982**
P. J. TURCHI Jun. 1982 100 p refs
(Contract F49260-82-C-0008; AF PROJ. 2308)
(AD-A119243; AFOSR-82-0717TR) Avail: NTIS HC A05/MF A01 CSCL 10B

By the year 2000, an increasingly large portion of our national defense will depend on space-based systems. As part of a broader set of new research initiatives in support of space systems, the Air Force Office of Scientific Research is sponsoring basic research that may be applicable to the development of megawatt-level space prime-power systems. (The emphasis of this particular new initiative is prime-power versus pulsed power including power conditioning, such as fly-wheel or inductive storage, for which there are existing programs.) To assist AFOSR, R and D Associates organized a special conference on prime-power for high-energy space systems, compiled the proceedings of the conference, and provided a review document identifying basic research areas in support of future space prime-power development. This document is the Appendix of the present report. The intent has been to focus on basic vs applied research and to provide guidance and assistance to prospective researchers. In this last regard, a bibliography of space prime-power is contained in the appended document.
Author (GRA)

**N83-14545#** Sandia Labs., Albuquerque, N. Mex.
**STRUCTURAL-DYNAMIC-RESPONSE CHARACTERISTICS OF DARRIEUS VERTICAL AXIS WIND TURBINES**
W. N. SULLIVAN 1981 26 p refs Presented at the 5th Biennial Wind Energy Conf. And Workshop, Washington, D.C., 5 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-003583; SAND-81-1760C; CONF-811043-10) Avail: NTIS HC A03/MF A01

Operational experience with Darrieus type vertical axis wind turbines (VAWTs) indicated that a variety of dynamic issues can affect structural performance of the system. The observation and analysis of structural dynamic responses in the VAWT were divided among three major aspects of the system: rotor vibrations, torsional response of the drive train, and transverse vibrations of the cables. This division is not arbitrary, but can be accurately decoupled from each other in most circumstances. The status of the analytical tools, the quanity and quality of existing experimental confirmation data, and the implications structural dynamic issues have on rotor design are discussed.

**N83-14684*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**LITHIUM/SULFUR DIOXIDE CELL AND BATTERY SAFETY**
G. HALPERT and A. ANDERSON Nov. 1982 19 p refs
(NASA-RP-1099; NAS 1.61:1099) Avail: NTIS HC A02/MF A01 CSCL 10C

The new high-energy lithium/sulfur dioxide primary electrochemical cell, having a number of advantages, has received considerable attention as a power source in the past few years. With greater experience and improved design by the manufacturers, this system can be used in a safe manner provided the guidelines for use and safety precautions described herein are followed. In addition to a description of cell design and appropriate definitions, there is a safety precautions checklist provided to guide the user. Specific safety procedures for marking, handling, transportation, and disposal are also given, as is a suggested series of tests, to assure manufacturer conformance to requirements. Author

**N83-14688*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE EFFECT OF YAW ON HORIZONTAL AXIS WIND TURBINE LOADING AND PERFORMANCE**
J. C. GLASGOW, R D. CORRIGAN, and D. R MILLER 1980 22 p refs Presented at the fifth Biennial Wind Energy Conf. and Workshop, Washington, D.C., 5-7 Oct. 1980, sponsored by DOE
(Contract DE-AI07-76ET-20320)
(NASA-TM-82778; E-1108, DOE/NASA/20320-35; NAS 1.15 82778) Avail· NTIS HC A02/MF A01 CSCL 10A

The Mod-0 100 kW experimental wind turbine was tested to determine the effects of yaw on rotor power, blade loads and teeter response. The wind turbine was operated for extended preiods at yaw angles up to 49 deg to define average or mean response to yaw. It was determined that the effect of yaw on rotor power can be approximated by the cube of the velocity normal to the rotor disc as long as the yaw angle is less than 30 deg. Blade bending loads were relatively unaffected by yaw, but teeter angle increased with wind speed as the magnitude of the yaw angle exceeded 30 deg indicating a potential for teeter stop impacts at large yaw angles No other adverse effects due to yaw were noted during the tests. S.L.

**N83-14689*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
**MEASURED PERFORMANCE OF A TIP-CONTROLLED, TEETERED ROTOR WITH AN NACA 64 SUB 3-618 TIP AIRFOIL**
R. D. CORRIGAN, J. C GLASGOW, and P. J SIROCKY 1982 16 p refs Presented at the Wind and Solar Energy Conf., Kansas City, Mo , 5-7 Apr 1982
(Contract DE-AI01-76ET-20320)
(NASA-TM-82870; DOE/NASA/20320-40, E-1240, NAS 1 15:82870) Avail: NTIS HC A02/MF A01 CSCL 10A

Tests were conducted on the Mod-O 100 kW Wind Turbine to determine the performance of a tip-controlled rotor having an NACA 64 sub-618 airfoil over the moveable outboard 30% of the blade, while operating at nominal rotor speeds of 21 and 31 rpm. Tests were conducted at two rotor speeds to assess the performance improvement which could be realized with 2-speed operation. Test data are compared with analytical predictions and concluding remarks are presented. The results indicate a clear performance improvement for the 2-speed operation. Author

**N83-14690*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DOE/NASA LEWIS LARGE WIND TURBINE PROGRAM**
R. L THOMAS 1982 15 p refs Presented at the Natl. Rural Elec Coop. Assoc and DOE Rural Elec. Wind Energy Workshop, Boulder, Colo., 1-3 Jun. 1982
(Contract DE-AI01-76ET-20320)
(NASA-TM-82991; DOE/NASA/20320-42; E-1423; NAS 1.15.82991) Avail· NTIS HC A02/MF A01 CSCL 10A

An overview of the large wind turbine activities managed by NASA is given. These activities include resuls from the first and second generation field machines (Mod-0A, -1, and -2), the status of the Department of Interior WTS-4 machine for which NASA is responsible for technical management, and the design phase of the third generation wind turbines (Mod-5) R.J.F.

**N83-14691*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**ASSESSMENT OF ALTERNATIVE POWER SOURCES FOR MOBILE MINING MACHINERY**
J E. CAIRELLI, W. A. TOMAZIC, D. G. EVANS, and J L. KLANN Dec. 1981 109 p refs
(NASA-TM-82695, E-978; NAS 1.15:82695) Avail: NTIS HC A06/MF A01 CSCL 08I

Alternative mobile power sources for mining applications were assessed. A wide variety of heat engines and energy systems was examined as potential alternatives to presently used power systems. The present mobile power systems are electrical trailing cable, electrical battery, and diesel - with diesel being largely limited in the United States to noncoal mines. Each candidate power source was evaluated for the following requirements: (1) ability to achieve the duty cycle, (2) ability to meet Government regulations; (3) availability (production readiness); (4) market availability; and (5) packaging capability. Screening reduced the list of candidates to the following power sources: diesel, stirling, gas turbine, rankine (steam), advanced electric (batteries), mechanical energy storage (flywheel), and use of hydrogen evolved from metal hydrides. This list of candidates is divided into two classes of alternative power sources for mining applications, heat engines and energy storage systems. E.A.K.

**N83-14693*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
**GAS-TO-HYDRAULIC POWER CONVERTER Patent**
C. W. GALLOWAY, Inventor (to NASA) 27 Feb. 1981 7 p Filed 27 Feb. 1981 Supersedes N81-24445 (19 - 15, p 2063)
(NASA-CASE-MSC-18794-1; US-PATENT-4,360,325, US-PATENT-APPL-SN-238785, US-PATENT-CLASS-417-399; US-PATENT-CLASS-74-110) Avail: US Patent and Trademark Office CSCL 10B

A gas piston driven hydraulic piston pump is described in which the gas cycle is of high efficiency by injecting the gas in slugs at the beginning of each power stroke. The hydraulic piston is disposed to operate inside the as piston, and the two pistons, both slidably but nonrotatably mounted, are coupled together with a rotating but non-sliding motion transfer ring extending into antifriction grooves in the sidewalls of the two pistons. To make the hydraulic piston move at a constant speed during constant hydraulic horsepower demand and thus exert a constant pressure on the hydraulic fluid, these grooves are machined with variable pitches and one is the opposite of the other, i.e., the gas piston groove increases in pitch during its power stroke while the hydraulic piston groove decreases. Any number of piston assembly sets may be used to obtain desired hydraulic horsepower.
Official Gazette of the U.S. Patent and Trademark Office

**N83-14740#** Naval Civil Engineering Lab., Port Hueneme, Calif.
**OPERATING AND MAINTENANCE EXPERIENCE WITH A 6-KW WIND ENERGY CONVERSION SYSTEM AT NAVAL STATION, TREASURE ISLAND, CALIFORNIA Technical Report, Sep. 1979 - Jun. 1981**
D. PAL Jul. 1982 55 p
(AD-A119389; NCEL-TN-1641) Avail: NTIS HC A04/MF A01 CSCL 10B

This report describes in detail the experience gained and lessons learned from the 6-kW grid-integrated Wind Energy Conversion System (WECS) demonstration at Naval Station, Treasure Island, San Francisco Bay. The objective of this demonstration was to develop operating experience and maintenance information on the 6-kW WECS using a combination of permanent magnet alternator with a line commutated synchronous inverter. The on-site measurements conducted during the demonstation indicate that the WECS site has annual average windspeeds of about 8 to 10 mph. The test results to data indicate a satisfactory performance of the WECS except for two failures involving arcing at the electrical terminals located on the yaw shaft. Due to wind characteristics encountered at the site, the performance data collected to date are at windspeeds of 20 mph or lower. For evaluating the WECS performance at all windspeeds, location at a windier site with annual average windspeeds of 14 mph or higher is recommended. Author (GRA)

**N83-14746#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
**GUST STRUCTURE ANALYSIS FOR WECS: DESIGN AND PERFORMANCE ANALYSIS**
R. E. AKINS Dec. 1981 156 p refs
(Contract DE-AC06-79ET-23007)
(DE82-005321; DOE/ET-23007/80/2) Avail: NTIS HC A08/MF A01

The gust structure of the wind at a mid-Atlantic coastal location is documented. Three definitions of gust structure are developed, and data corresponding to two distinct flow regimes, onshore and offshore, are presented. These two cases correspond to very different upwind terrain and offer two distinct flows at one site. Detailed three dimensional wind measurements, obtained using a 76-m meteorological tower located on the coast of the Atlantic Ocean at Wallops Island, Virginia, were utilized. In all instances the number of gusts per unit time increases with mean wind speed and turbulence intensity and decreases with increasing height. The duration of the gusts increases with height and mean wind speed, their amplitude decreases with height and increases with turbulence intensity. It may be possible to predict the amplitude of descrete gusts directly from information concerning the turbulence intensity. DOE

**N83-14747#** California Univ., Livermore. Lawrence Livermore Lab
**ENERGY AND TECHNOLOGY REVIEW**
Jun 1982 28 p refs
(Contract W-7405-ENG-48)
(DE82-019371; UCRL-52000-82-6) Avail: NTIS HC A03/MF A01

Reviews of research programs are presented. Fast and precise measurement techniques to meet the demanding specifications for microsphere targets used in inertial confinement fusion experiments are described. A program in which a Raman spectroscopy microprobe is used to perform molecular structure analyses on submicron size particles is discussed. The first year of the controlled thermonuclear reactions program is reported. DOE

**N83-14756#** Sandia Labs., Albuquerque, N. Mex.
**THE 17-M VAWT PROGRAM**
R. O. NELLUMS 1981 22 p refs Presented at the 5th Biennial Wind Energy Conf. and Workshop, Washington, D.C., 5 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-003497; SAND-81-1756C, CONF-811043-11) Avail: NTIS HC A02/MF A01

The commercial potential of the 17 m, 100 kW Darrieus Vertical Axis Wind Turbine (VAWT) is discussed. Long term testing is in progress. As the first commercially adapted Darrieus turbines built by DOE, the superior cost, structural integrity, and output characteristics demonstrated by the prototypes appear particularly promising. DOE

**N83-14760#** Sandia Labs., Albuquerque, N. Mex.
**AERODYNAMICS AND PERFORMANCE TESTING OF THE VAWT**
P. C. KLIMAS 1981 11 p refs Presented at the 5th Biennial Wind Energy Conf. and Workshop, Washington, D.C., 5 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-003574; SAND-81-1702C; CONF-811043-9) Avail: NTIS HC A02/MF A01

Relatively inexpensive changes to the current aerodynamic design which may bring about reductions in cost of energy (COE) and increases in reliability for VAWT systems are discussed. This design uses blades of symmetrical cross section mounted such that the radius from the rotating tower centerline is normal to the blade chord at roughly the 40% chord point. The envisioned changes to this existing design are intended to: (1) lower cut in windspeed; (2) increase maximum efficiency; (3) limit maximum aerodynamic power; and (4) limit peak aerodynamic torques. Experiments to better understand the aerodynamics of a section operating in an unsteady, curvilinear flowfield and achieve some of the desired changes in section properties are described. GRA

**N83-15104#** California Univ., Berkeley. Lawrence Berkeley Lab.
**LAWRENCE BERKELEY LABORATORY NEUTRAL-BEAM ENGINEERING TEST FACILITY POWER-SUPPLY SYSTEM**
I. C. LUTZ, C. A. ARTHUR, G. J. DEVRIES, and H. M. OWREN Oct. 1981 5 p refs Presented at the 9th Symp. on Engr. Probl. of Fusion Res., Chicago, 26-29 Oct. 1981
(Contract W-7405-ENG-48)
(DE82-003044; LBL-12722; CONF-811040-86) Avail: NTIS HC A02/MF A01

The Lawrence Berkeley Laboratory is upgrading the neutral beam source test facility into a neutral beam engineering test facility (NBETF) with increased capabilities for the development of neutral beam systems. The NBETF will have an accel power supply capable of 170 kV, 70 A, 30 sec pulse length, 10% duty cycle; and the auxiliary power supplies required for the sources. The major components, their ratings and capabilities, and the flexibility designed to accommodate the needs of source development are described DOE

**N83-15110#** Illinois Univ., Urbana. Fusion Studies Lab.
**ADVANCED FUEL CONCEPTS AND APPLICATIONS**
G. H. MILEY 1981 13 p refs Presented at Meeting and Workshop on Fusion Reactor Design and Technol., Tokyo, 5 Oct. 1981
(Contract DE-AS02-76ET-52040)
(DE82-002710; COO-2218-230; CONF-811046-10) Avail: NTIS HC A02/MF A01

Advanced fuel (AF) fusion cycles when potentially offer improved environmental compatibility and lower costs are discussed. This comes about by elimination of tritium breeding requirements and by a reduction in neutron flux. Also a larger energy fraction carried by charged particles makes direct energy conversion more suitable. As a first application, a symbiotic system of semicatalyzed deuterium fueled hybrid fuel factories, supplying both fissle fuel to light water reactors and 3He to D-3He satellite fusion reactors, is proposed. Subsequently, an evolution into a system of synfuel factories with satellite D-3He reactors is envisioned. GRA

**N83-15111#** California Univ., Livermore. Lawrence Livermore Lab.
**ASSESSMENT OF SOME OF THE PROBLEMS IN THE USA OF SUPERCONDUCTING MAGNETS FOR FUSION RESEARCH**
D. N. CORNISH 5 Nov. 1981 3 p Presented at the 9th Symp. on Eng. Probl. of Fusion Res., Chicago, 26-29 Oct. 1981
(Contract W-7405-ENG-48)
(DE82-003066; UCRL-86877; CONF-811040-105) Avail: NTIS HC A02/MF A01

Problems encountered during the development of superconductors and superconducting magnets for fusion are discussed. Under estimation and development and fabrication of superconductors are considered DOE

**N83-15116#** Sandia Labs., Albuquerque, N. Mex.
**PULSED POWER FOR INERTIAL-CONFINEMENT FUSION**
T. H. MARTIN, J. P. VANDEVENDER, D. L. JOHNSON, E. L. NEAU, W. B. BOYER, J. T. CROW, and B. N. TURMAN 1981 4 p refs Presented at the 9th Symp. on Engr. Problems of Fusion Res., Chicago, 26 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-001991; SAND-81-2446C; CONF-811040-35) Avail: NTIS HC A02/MF A01

Pulsed power development for inertial confinement fusion continues at a rapid rate. The scalability of these types of pulse power systems has been successfully demonstrated during the past few years through a continuum of fully modular, pulsed power accelerators at Sandia which include Proto I at 1 TW, Proto II at 11 TW, PBFA-I at 30 TW, and the projected PBFA-II at 100 TW. Several problems which have limited previous technology to a

few tens of terawatts have been solved or appear to have solutions. Several of these solutions are being incorporated into the PBFA-II baseline design which will be introduced. DOE

**N83-15117#** California Univ., Livermore Lawrence Livermore Lab
**HEAVY-ION INERTIAL FUSION: INITIAL SURVEY OF TARGET GAIN VERSUS ION-BEAM PARAMETERS**
R. O. BANGERTER, J. W. K. MARK, and A. R THIESSEN 26 Oct 1981 12 p refs Presented at the 22nd Ann Meeting of the Div of Plasma Phys of the APS, San Diego, Calif. 10-14 Nov. 1980
(Contract W-7405-ENG-48)
(DE82-003069; UCRL-84821-REV-1; CONF-801119-5-REV-1)
Avail: NTIS HC A02/MF A01

Inertial-fusion targets have been designed for use with heavy-ion accelerators as drivers in fusion energy power plants. We have made an initial survey of target gain versus beam energy, power, focal radius, and ion range. This provides input for understanding the trade-offs among accelerator designs. DOE

**N83-15118#** Sandia Labs., Albuquerque, N. Mex.
**PARTICLE-BEAM FUSION Progress Report, Jul. - Dec. 1980**
Oct. 1981 141 p refs
(Contract DE-AC04-76DP-00789)
(DE82-003107; SAND-81-0683) Avail: NTIS HC A07/MF A01

Progress in research of particle beam fusion is reported. The following topics are discussed: (1) fusion target studies, (2) target experiments, (3) particle beam souce theory, (4) diagnostics development, (5) particle beam experiments, (6) pulsed power research, and (7) pulsed power applications. GRA

**N83-15126#** Nagoya Univ. (Japan). Inst. of Plasma Physics.
**PROCEEDINGS OF INTERNATIONAL TOPICAL MEETING ON ICF RESEARCH BY LIGHT-ION BEAM**
K. YATSUI, ed. Oct. 1982 163 p refs Meeting held at Nagaoka, Japan, 11-12 May 1982 Sponsored in part by the Ministry of Education, Science and Culture of Japan
(IPPJ-611) Avail: NTIS HC A08/MF A01

High-brightness proton beams (.4 MA, 1 MV) have recently been extracted from 20 sq cm axial pinch-reflex diodes (PRDs) mounted on the NRL Gamble II generator. A source power brightness 10 TW/sq cm RAD(2) was achieved in these experiments. A new barrel-shaped equitorial PRD that can be coupled to PBFA-II has also been operated on Gamble II and has demonstrated 50% proton efficiency with predominantly azimuthally-symmetric charged-particle flow. In other experiments the stopping of power deuterons in hot plasmas was measured using a PRD on Gamble II. Results show about 40% enhancement in stopping power over that in cold targets when the beam was focused to about .25 MA/sq cm. Research is also being performed on transporting ion beams in large-diameter channels ( 2.5 cm) and on a post-transport, plasma-filled, magnetic-focusing section to bring the beam to pellet dimensions. Author

**N83-15132#** Wisconsin Univ., Madison. Dept. of Nuclear Engineering.
**FUSION MATERIALS: ADAPTING TO REALISTIC REACTOR ENVIRONMENTS**
G. L. KULCINSKI Oct. 1981 25 p refs Presented at the Meeting and Workshop on Fusion Reactor Design and Technol., Tokyo, 5-16 Oct. 1981 Sponsored in part by the Wisconsin Electric Utilities Research Foundation
(Contract DE-AS02-78ET-52048)
(DE82-002708; DOE/ET-52048/21; UWFDM-437; CONF-811046-11) Avail: NTIS HC A02/MF A01

There has been considerable movement in the fusion materials field since the last International Workshop on Reactor Design was held in Madison (1977). Some of the movement has been forward; e.g., we now have much better theoretical descriptions of the melting, vaporization, and electromechanical stresses imposed on first wall material during plasma disruptions. Some of the movement has been sideways, e.g., the Fusion Materials Irradiation Test Facility (FMIT) now has slipped 3 years in its schedule since the last conference 4 years ago. Finally, there has been very little progress in the fields of pulsed damage simulation for Inertial Confinement Fusion (ICF) Systems, definition of the radiation spectra from ICF targets, or the experimental determination of disruption characteristics for magnetic fusion devices. Several new ideas have appeared since 1977 such as the use of low swelling martensitic alloys, the use of a much more favorable breeding material, Pb83Li17, and there have been two major efforts to design materials test facilities: INTOR and TASKA. DOE

**N83-15133#** California Univ., Livermore. Lawrence Livermore Lab.
**UTILIZING SUBCOOLED, SUPERFLUID HE-II IN THE DESIGN OF A 12-TESLA TANDEM-MIRROR EXPERIMENT**
R. W HOARD, D. N CORNISH, R. W. BALDI, and W. D. TAYLOR 11 Nov. 1981 10 p refs Presented at the Workshop on Stability of Superconducting in He-I and He-II, Saclay, France, 16-19 Nov. 1981 Prepared in cooperation with General Dynamics, San Diego, Calif.
(Contract W-7405-ENG-48)
(DE82-003322; UCRL-86326; CONF-811140-1) Avail: NTIS HC A02/MF A01

A design study of 12-T yin-yang coils for a conceptual tandem mirror next step (TMNS) facility was performed. The large magnets have major and minor radii of 3.7 and 1.5 m, 0.70 x 3.75 sq m cross section, 46.3 MA turns, and an overall current density of 1765 A/sq cm, obtained by the use of Nb3Sn and Nb-Ti superconductors. Each coil is composed of several subcoils separated by internal strengthening substructure to react the enormous electromagnetic forces The size of the yin-yang coils, and hence the current density, was reduced by utilizing subcooled, superfluid He-II at 1.8 K for the coolant. The design study is reviewed with emphasis on He-II heat transport and conductor stability. Methods are also presented which allow the extension of Gorter-Mellink-channel calculations to encompass multiple, interconnecting coolant channels. DOE

**N83-15134#** California Univ., Livermore. Lawrence Livermore Lab.
**DESIGNS OF TANDEM-MIRROR FUSION REACTORS**
G. A. CARLSON, W. L. BARR, B. M. BOGHOSIAN, R. S. DEVOTO, J N. DOGGETT, G. W. HAMILTON, B. M. JOHNSTON, J. D. LEE, B. G. LOGAN, R. W. MOIR et al. 1 Oct. 1981 21 p refs Presented at the Meeting and Workshop on Fusion Reactor Design and Technol , Tokyo, 5-16 Oct. 1981
(Contract W-7405-ENG-48)
(DE82-000845; UCRL-86576; CONF-811046-8) Avail: NTIS HC A02/MF A01

A comparative evaluation of several end plug configurations for tandem mirror fusion reactors with thermal barriers were completed. The axi-cell configuration was selected for further study. The axi-cell end plug has a simple mirror cell produced by two circular coils followed by a transition coil and a yin-yang pair, which provides for MHD stability. DOE

**N83-15135#** Wisconsin Univ., Madison. Dept. of Nuclear Engineering.
**CONCEPTUAL DESIGN FOR A MODULAR-STELLARATOR FUSION-REACTOR MAGNET**
S. W. VANSCIVER, A. KHALIL, K. Y. YUAN, and I. N. SVIATOSLAVSKY Oct. 1981 5 p refs Presented at the 9th Symp. on Eng. Probl. of Fusion Res., Chicago, 26-29 Oct. 1981
(Contract DE-AS02-78ET-52048)
(DE82-002863; DOE/ET-52048/22; UWFDM-448, CONF-811040-114) Avail: NTIS HC A02/MF A01

The design of a modular stellarator fusion reactor UWTOR-M is examined. The reactor configuration employs 18 twisted toroidal field coils with a major radius of 24.1 m, a minor radius of 4.77 m and a field of 5 5 tesla on axis. The conductor is bath cooled with pressurized superfluid helium to achieve high current density cryostability. The coil case is a stainless steel structure designed to withstand bending moments resulting from self force on the

individual coil and the interactive force between adjacent coils. Force components in the radial, poloidal and toroidal directions are calculated for the individual coils using EFFI. These loads are transferred through fiberglass composite struts to a room temperature central concrete column. GRA

**N83-15136#** California Univ., Livermore. Lawrence Livermore Lab
**MAGNET AND CONDUCTOR DEVELOPMENTS FOR THE MIRROR FUSION PROGRAM**
D. N. CORNISH 9 Oct. 1981 18 p refs Presented at the US-Japan Superconductive Magnetic Energy Storage Workshop, Madison, Wis., 19-23 Oct. 1981
(Contract W-7405-ENG-48)
(DE82-001062; UCRL-86777; CONF-811051-1) Avail: NTIS HC A02/MF A01

The conductor development and the magnet design and construction for the MFTF are described. Future plans for the mirror program and their influence on the associated superconductor development program are discussed. Progress to develop large, high field, multifilamentary Nb3Sn superconductors and the feasibility of building a 12-T yinyang set of coils for the machine to follow MFTF is summarized. Possible magnetic configurations and requirements for mirror reactors are surveyed. GRA

**N83-15139#** California Univ., Livermore. Lawrence Livermore Lab.
**ANALYTICAL AND NUMERICAL CALCULATIONS OF FIELD-REVERSED THETA-PINCH EQUILIBRIA BASED ON A GENERALIZED HILL'S VORTEX MODEL**
D V ANDERSON, J. H. HAMMER, and D. C. BARNES Oct. 1981 5 p refs Presented at the 4th Ann. Compact Toroid Symp., Livermore, Calif , 27-29 Oct 1981
(Contract W-7405-ENG-48)
(DE82-003150; UCRL-86831; CONF-811087-13) Avail: NTIS HC A02/MF A01

Methods for numerically extending the analytic solutions of field reversed theta pinch equilibria so that the results may be used in various stability and dynamics studies were investigated. Generalizations of elliptical Hill's equilibria which accomodate separatrices with more rectangular shapes and which allow plasma to exist outside the separatrix were used. Although the equilibria are specified analytically inside the plasma surface, numerical techniques are required to generate the solution in the vacuum region. Two computer codes were used in sequence. The first determines a set of external coils and their currents so that they match the known coil field inside the plasma. Then, given this coil field, we compute the contribution from the plasma currents to the fields in the vacuum region. DOE

**N83-15140#** Sandia Labs., Albuquerque, N. Mex.
**TRANSPORT OF LIGHT-ION BEAMS IN PLASMA CHANNELS**
J. N. OLSEN 1981 9 p refs Presented at 9th Symp. on Eng. Problems of Fusion Res., Chicago, Ill., 26 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-001649; SAND-81-1333C; CONF-811040-34) Avail: NTIS HC A02/MF A01

Experimental work of ions which propagated in wire initiated and laser initiated discharge channels is reported. Intense beams of light ions are transported over distances of 1 to 2 meters in plasma channels in progress toward inertial confinement fusion driven by particle beams. Particular emphasis is given to studies on laser initiation and channel stability. GRA

**N83-15141#** Oak Ridge National Lab., Tenn.
**RESISTIVE MHD STUDIES OF HIGH-BETA-TOKAMAK PLASMAS**
V. E. LYNCH, B. A. CARRERAS, H. R. HICKS, J. A. HOLMES, and L. GARCIA 1981 40 p refs Presented at European Workshop on the Behavior of Magnetically Confined plasmas, Wildhaus, Switzerland, 9 Sep 1981
(Contract W-7405-ENG-26)
(DE82-001478; CONF-810947-4-DRAFT) Avail: NTIS HC A03/MF A01

Numerical calculations have been performed to study the MHD activity in high-delta Tokamaks such as ISX-B. These initial value calculations built on earlier low beta techniques, but the beta effects create several new numerical issues. These issues are discussed and resolved. In addition to time-stepping modules, our system of computer codes includes equilibrium solvers (used to provide an initial condition) and output modules, such as a magnetic field line follower and an X-ray diagnostic code. The transition from current driven modes at low beta to predominantly pressure driven modes at high beta is described. The nonlinear studies yield X-ray emissivity plots which are compared with experiment. DOE

**N83-15142#** Los Alamos Scientific Lab , N. Mex.
**MULTIDIMENSIONAL MHD COMPUTATIONS FOR THE FIELD-REVERSED THETA PINCH AND THE REVERSED-FIELD PINCH**
D. D. SCHNACK 1981 11 p refs Presented at the US/Japan Workshop on 3D MHD Studies for Toroidal Devices, Oak Ridge, Tenn., 19 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-004361; LA-UR-81-3527; CONF-8110101-2) Avail: NTIS HC A02/MF A01

Some large scale numerical MHD simulations of field reversed theta pinch and reversed field pinch devices are described. DOE

**N83-15143#** Sandia Labs., Albuquerque, N. Mex.
**DEUTERIUM FLUX MEASUREMENTS IN THE EDGE PLASMAS OF PLT AND PDX DURING AUXILIARY HEATING EXPERIMENTS**
W. R WAMPLER, S. A. COHEN (Princeton Univ.), H. F. DYLLA (Princeton Univ.), D. M MANOS (Princeton Univ.), and C W. MAGEE (RCA Labs.) 1981 14 p refs Presented at the Am. Vacuum Soc. Natl. Symp., Anaheim, Calif , 3 Nov. 1981
(Contract DE-AC04-76DP-00789)
(DE82-001909; SAND-81-2205C; CONF-811113-25) Avail: NTIS HC A02/MF A01

The flux of deuterium in the plasma edge several centimeters outside the limiter were measured using collector probes during neutral beam heating experiments on the PDX Tokamak and RF heating experiments on the PLT Tokamak. The dependence of the flux on the distance from the plasma was determined, and the time dependence of the flux was measured with a time resolution of 90 ms. In PDX the deuterium flux decreased rapidly with increasing distance from the plasma. The deuterium flux increased strongly when the beams came on and decreased when they turned off. The depth distribution of the deuterium in the samples, measured using SIMS, shows that when the beams are on about 30% of the deuterium incident on the probe is superthermal deuterium from the beams. In the deuterium flux decreased only slightly with increasing distance from the plasma. The ICRH heating in PLT caused an increase of about 30% in the flux of deuterium to the samples and in the plasma density. In both machines the the deuterium fluxes were fairly low at the positions sampled. DOE

**N83-15144#** Technische Hogeschool, Eindhoven (Netherlands). Direct Energy Conversion Group.
**EFFECT OF RADIATION AND NON-MAXWELLIAN ELECTRON DISTRIBUTION ON RELAXATION PROCESSES IN AN ATMOSPHERIC CESIUM SEEDED ARGON PLASMA**
C A. BORGHI, A. VEEFKIND, and J. M. WETZER Mar. 1982 30 p refs
(EUT-82-E-124; ISBN-90-6144-124-2) Avail: NTIS HC A03/MF A01

A model, describing the time dependent behavior of a noble gas MHD generator plasma, was set up. The model calculates the relaxation for ionization or recombination as a stepwise temperature development, once the initial and final conditions are given. Radiative transitions and a deviation from Maxwellian electron distribution are included in the model. Radiation causes an enhancement of both the ionization relaxation time and the recombination relaxation time A non-Maxwellian electron distribution results in an increase of the relaxation time for an ionizing plasma because of an underpopulation of the high energy electrons. A decrease of the relaxation time for a recombining plasma is caused by an overpopulation of high energy electrons. The relaxation time is strongly dependent on the seed ratio and the temperature step. Author (ESA)

**N83-15176*#** Mechanical Technology, Inc , Latham, N. Y. Stirling Engine Systems Div.
**AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Semiannual Technical Progress Report, 1 Jul. - 31 Dec. 1981**
W. ERNST, S. PILLER, A. RICHEY, M SIMETKOSKY, and M. ANTONELLI, ed. Sep 1982 84 p refs
(Contract DEN3-32; EC-77-A-31-10040)
(NASA-CR-167907-2; NAS 1.26.167907; DOE/NASA-0032-15, REPT-82ASE248SA1) Avail: NTIS HC A05/MF A01 CSCL 13F

Activities performed on Mod I engine testing and test results, progress in manufacturing, assembling and testing of a Mod I engine in the United States, P40 Stirling engine dynamometer and multifuels testing, analog/digital controls system testing, Stirling reference engine manufacturing and reduced size studies, components and subsystems, and computer code development are summarized. Author

**N83-15177*#** Mechanical Technology, Inc , Latham, N. Y. Stirling Engine Systems Div
**AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Semiannual Technical Progress Report, 1 Jan. - 30 Jun. 1982**
N. NIGHTINGALE, W. ERNST, A RICHEY, M. SIMETKOSKY, and M. ANTONELLI, ed. Oct. 1982 65 p refs
(Contract DEN3-32; EC-77-A-31-10040)
(NASA-CR-167907-1, NAS 1 26:167907, DOE/NASA-0032-15; REPT-82ASE278SA2) Avail: NTIS HC A04/MF A01 CSCL 13F

Activities performed on Mod I engine testing and test results; the manufacture, assembly, and test of a Mod I engine in the United States; design initiation of the Mod I-A engine system, transient performance testing; Stirling reference engine manufacturing and reduced size studies; components and subsystems; and the study and test of low cost alloys are summarized. Author

**N83-15839*#** Engelhard Industries, Inc., Edison, N.J.
**DEVELOP AND TEST FUEL CELL POWERED ON-SITE INTEGRATED TOTAL ENERGY SYSTEM Quarterly Report**
A. KAUFMAN and G. K JOHNSON 3 Nov 1982 47 p
(Contract DEN3-241; DE-AI01-80ET-17088)
(NASA-CR-168020; NAS 1.26:168020; QR-5) Avail: NTIS HC A03/MF A01 CSCL 10A

Satisfactory performance is reported for the first 12-cell sub-stack of the 5 kW rebuild using improved ABA reactant distribution plates. Construction and test results are described for the first full-sized single-cell test (0.33 m x 0.56 m). Test duration was 450 hours. Plans are outlined for construction and testing of two methanol reformer units based on commercially-available shell-and-tube heat exchangers. A 5 kW-equivalent precursor and a 50 kW-equivalent prototype will be built. Supporting design and single-tube experimental data are presented. Stack support efforts are summarized on corrosion currents of graphite materials and acid-management of single-cell test facilities. Comparative properties are summarized for the two methanol/steam reforming catalysts evauated under Task V (now completed); T2107RS and C70-2RS. Author

**N83-15841#** R and D Associates, Rosslyn, Va.
**PROCEEDINGS OF THE AFOSR SPECIAL CONFERENCE ON PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS, VOLUME 1 Final Report**
P. J. TURCHI 1982 767 p refs Conf. held in Norfolk, Va., 22-25 Feb. 1982 2 Vol.
(Contract F49620-82-C-0008)
(AD-A118887; AFOSR-82-0655TR-VOL-1) Avail: NTIS HC A99/MF A01 CSCL 10B

State-of-the-art space prime-power technology is reviewed Research needs for progress toward megawatt power levels are discussed. Chemical, nuclear, and radiant energy techniques, power conversion, heat rejection, materials, chemical and fluid physics are discussed.

**N83-15842#** Boeing Aerospace Co., Seattle, Wash.
**POWER REQUIREMENTS FOR MANNED SPACE STATIONS**
G. R. WOODCOCK and S. SILVERMAN *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 1 20 p 1982
Avail. NTIS HC A99/MF A01 CSCL 10B

The power requirements, the tradeoff between batteries and regenerative fuel cells, including how the electric power system can be integrated with other functions, and nuclear concepts are summarized The influence of mission applications on selection of the power system is discussed, including low Earth orbit and high Earth orbit civil missions and potential military missions. Author

**N83-15844#** Eagle-Picher Industries, Inc., Joplin, Mo. Electronics Div.
**CHEMICAL SOURCES: BATTERY**
R. A. BROWN *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 12 p 1982
Avail. NTIS HC A99/MF A01 CSCL 10C

The particular aspects of space power requirements that are critical to batteries are discussed Power density and energy density values for various electrochemical systems and battery configurations are shown as a function of the time duration of the power pulse. Characteristics of the possible battery systems are listed in order to match specific battery systems to individual power requirements A general discussion is presented regarding the advantages batteries offer over other types of power sources. Author

**N83-15846#** R and D Associates, Rosslyn, Va.
**MHD POWER: OVERVIEW**
J. B. DICKS (Applied Energetics, Inc ) *In its* Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol 1 17 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10B

MHD is one of those technologies which has reached an engineering status that would allow it to be applied where the need for short time high powered systems arises It has the advantage of almost immediate full power production from a inert start, is thus capable of high reliability, but is limited in time to that available utilizing uncooled heat sink configurations. Such a time at present is of the order of 100-150 seconds with extended lifetime depending on the amount of cooling are placed in the system. All of this technology is based on an engineering understanding of the device, but comparatively little physical understanding. The phenomenon involved are complex, involving a combination of Maxwell's equations with the gasdynamic equations. Furthermore, the phenomena of the boundary layer

between the hot plasma and the cold electrodes are in a even more difficult regime of temperature over shoots, recombination, surface interaction, and prevalent surface phenomena. Author

**N83-15847*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**NASA LEWIS RESEARCH CENTER COMBUSTION MHD EXPERIMENT**
J. M. SMITH *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 10 p 1982 refs
Avail: NTIS HC A99/MF A01 CSCL 10B

The MHD power generation experiments were conducted in a high field strength cryomagnet which was adapted from an existing facility. In its original construction, it consisted of 12 high purity aluminum coils pool cooled in a bath of liquid neon. In this configuration, a peak field of 15 tesla was produced For the present experiments, the center four coils were removed and a 23 cm diameter transverse warm bore tube was inserted to allow the placement of the MHD experiment between the remaining eight coils. In this configuration, a peak field of 6 tesla should be obtainable. The time duration of the experiment is limited by the neon supply which allows on the order of 1 minute of total operating time followed by an 18-hour reliquefaction period. As a result, the experiments are run in a pulsed mode. The run duration for the data presented here was 5 sec. The magnetic field profile along the MHD duct is shown Since the working fluid is in essence superheated steam, it is easily water quenched at the exit of the diffuser and the components are designed vacuum tight so that the exhaust pipe and demister an be pumped down to simulate the vacuum of outer space. Author

**N83-15848#** Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
**THE MHD DISK GENERATOR AS A MULTIMEGAWATT POWER SUPPLY OPERATING WITH CHEMICAL AND NUCLEAR SOURCES**
J F. LOUIS *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 1 17 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10B

The characteristics, performance and status of the MHD disk generator are reviewed as a potential multimegawatt power supply working with both chemical and nuclear sources. The disk generator is found to be a compact high interaction power unit with simple construction simple power conditioning and using a circular superconducting coil. The radial flow of the disk assures zero thrust in open loop operation and its construction simplicity may provide significant reliability and weight advantages. The disk generator can be operated as a high voltage, low current power supply. Experiments have shown the disk generator as high power (900 kW), high power density (500 MW/cu cm), high enthalpy extraction (15%) device which has been operated with electrical fields up to 37 kV/m. The disk generator can be operated in an open loop with either chemical or nuclear heat sources. In a closed cycle system, the disk generator can be used in a Brayton cycle using He working fluid and in a Rankin cycle using either potassium or lithium vapors as working fluid. In both cases, the generator operates in the non-equilibrium mode. Author

**N83-15849#** STD Research Corp., Arcadia, Calif.
**SELF-EXCITED MHD POWER SOURCE FOR SPACE APPLICATIONS**
C. D. MAXWELL, C. D. BANGERTER, and S. T. DEMETRIADES *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy space Systems, Vol. 1 11 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10B

Small, self-excited, combustion-driven MHD systems with mass-to-power ratios of the order 1 kg/kW and specific energy extraction rates of 0.8 MJ/kg of fuel were tested. Small, self-excited, chemical explosion-driven giant-pulse generators with mass-to-power ratios of the order 0.001 kg/kW and specific energy extraction rates of 0.4 MG/kg of explosive were tested. The experimental, results to date with CW-MHD and Pulsed MHD devices are extrapolated to the expected performance in the space environment. The fluid mechanics of high-interaction, moderate-to-high magnetic Reynolds number MHD flows govern (and will ultimately limit) the performance of such devices. These fundamental limitations must be properly understood before devices of these or better specifications can be constructed. Author

**N83-15850#** Argonne National Lab., Ill.
**LIQUID-METAL MHD FOR SPACE POWER SYSTEMS**
E. S. PIERSON *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 14 p 1982 refs
Avail: NTIS HC A99/MF A01 CSCL 10B

The two-phase-generator liquid-metal MHD (LMMHD) energy-conversion concept, developed at Argonne National Laboratory, appears very attractive for space applications. It combines the high-temperaure capability and high power density of the previous-proposed LMMHD concepts with a high cycle efficiency unattainable with these previous LMMHD concepts. The operation of the Brayton-cycle (gas-cycle) and Rankine-cycle (vapor-cycle) two-phase-generator LMMHD concepts is explained. The key features which make LMMHD attractive for space applications are summarized. The current status of LMMHD technology is discussed, with emphasis on the experimental data. ANL has the technology base to analyze LMMHD systems for space power applications, and to build prototypes at different temperatures. Author

**N83-15851#** AMAF Industries, Columbia, Md.
**SOLAR MHD SYSTEMS WITH TWO-PHASE FLOW WITH MAGNETIC LIQUID METAL**
A. GOSWAMI, R. D. GRAVES, and C. SPIGHT *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 7 p 1982 refs
Avail: NTIS HC A99/MF A01 CSCL 10A

Solar power is one of the major resources available to space systems. Whereas the technology of solar cells and its limitations are well known, there is another technique, solar LMMHD, pioneered by H. Branover and E. Pierson which shows promise as a relatively high efficiency, inexpensive and compact prime power device usable in space. The solar LMMHD system employs a liquid metal to extract heat from a mirror-solar collector system. A second organic volatile liquid is then allowed to come in contact with the hot metal and evaporate. The two phase fluid system then moves along a pipe, the gas imparting part of its flow momentum to the liquid metal. The moving liquid metal passes through a magnetic field perpendicular to the flow direction; thereby an induced current is generated which is collected by the usual electrode ensemble. Author

**N83-15852#** Avco-Everett Research Lab., Mass.
**MAGNETOHYDRODYNAMIC POWER SUPPLY SYSTEMS FOR SPACE APPLICATIONS**
D. W. SWALLOM *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 34 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10B

The MHD power supply system can provide tens of megawatts of electrical power for space applications. The system has substantially operating flexibility for various operating times, pulse lengths and pulse rates, and power levels. The instant on/instant off capability provides the necessary response to command signals. The overall power system is a high efficiency, low mass and volume device which is attractive for space applications. Author

**N83-15853#** SeiTec, Cleveland, Ohio.
**POTENTIAL ROLE AND TECHNOLOGY STATUS OF CLOSED-CYCLE MHD FOR LIGHT-WEIGHT NUCLEAR SPACE-POWER SYSTEMS**
G. R. SEIKEL and B. ZAUDERER *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy space Systems, Vol. 1 15 p 1982 refs
Avail. NTIS HC A99/MF A01 CSCL 10B

If power is required in space for more than a large fraction of a day, steady state power sources (such as solar and nuclear) will have the lightest system weight. If megawatts of power are needed, closed cycle MHD systems (if successfully developed) have the potential of being very light and highly efficient. Such MHD generators are uniquely capable of fully exploiting advances in high-temperature reactor technology which could make up to 2500 K long-life, iner-gas-cooled reactors feasible A particularly attractive MHD system is a turbo-MHD cycle which has a turbine driven compressor. It potentially have very low specific mass, high efficiency, and relatively low MHD generator enthalpy extraction.
Author

**N83-15854#** Stanford Univ , Calif.
**MHD GENERATOR RESEARCH AT STANFORD**
J. K. KOESTER, C H. KRUGER, and T. NAKAMURA *In* R and D Associates Proc of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 22 p 1982 refs
Avail NTIS HC A99/MF A01 CSCL 10B

The behavior of MHD channels has been studied over a wide range of conditions in the High Temperature Gasdynamics Laboratory at Stanford University. This research is primarily experimental in nature with the use of advanced diagnostic methods and comparable theoretical and numerical studies for the interpretation of the data and application of the results to large-scale generators. Present MHD research areas include MHD boundary layer interactions, Hall-field breakdown, plasma nonuniformities, plasma fluctuations and magneto-acoustic waves, surface deposits of slag, disk generators, and electrode configurations. Plasma velocity, temperature, and electron number density have been measured with spatial and temporal resolution by optical diagnostics. Many channel phenomena such as electrode boundary layer Joule heating, sidewall boundary layer velocity overshoot, slag particle size, effect of radicals on electron density, and surface deposit polarization have been observed, measured, and compared with theory. These results are intended to provide support for MHD hardware development in areas where performance limitations and design constraints are not now adequately understood.
Author

**N83-15855#** Los Alamos Scientific Lab., N. Mex.
**OVERVIEW OF SPACE REACTORS**
D BUDEN *In* R and D Associates Proc of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 44 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10B

An overview of spacecraft power supplies needed in the future is presented in outline form. Subjects portrayed and discussed are: potential space power missions, space power technology capabilities, conversion technology, radiator technology, and reactor safety.
L.F M.

**N83-15856#** Oak Ridge National Lab., Tenn.
**TECHNOLOGICAL BOUNDARY CONDITIONS FOR NUCLEAR ELECTRIC SPACE POWER PLANTS**
A P FRAAS *In* R and D Associates Proc of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 1 20 p 1982 refs
Avail· NTIS HC A99/MF A01 CSCL 10B

A serious attempt to assess the potential and feasibility of the many candidates for nuclear electric space power applications must confront some basic technological facts that limit what one can reasonably hope to accomplish with ay given concept. First, the upper limit to the efficiency of any thermodynamic cycle was defined by Carnot, and the subsequent 160 years has not only disclosed the character and magnitude of the many losses that regretably but inevitably make the efficiency of any actual cycle much less than that of an ideal cycle, but has also shown the upper temperature limit attainable with the materials available for any actual cycle. The cycle efficiency determines not only the thermal energy output of the reactor required for any given electrical power output (and thus the size and weight of the reactor and shield assembly), but also the size and weight of the radiator to reject the waste heat. Materials considerations such as corrosion, strength, and radiation damage at elevated temperatures establish basic limits on the design of the reactor, shield, turbine, generator, and other key components. Allowable radiation doses to personnel, lubricants, elastomers, and electronic components determine the size, weight, and shape of the reactor shield after account is taken of such factors as activation of the reactor coolant, directional differences in the degree of shielding required for the spacecraft in question, and radiation scattering from structures such as the radiator. Further, an exceptionally high reliability with essentially no maintenance is required.
Author

**N83-15857#** Rasor Associates, Inc., Sunnyvale, Calif.
**EFFECTS OF REACTOR DESIGN, COMPONENT CHARACTERISTICS AND OPERATING TEMPERATURES ON DIRECT CONVERSION POWER SYSTEMS**
G. O FITZPATRICK and E. J. BRITT *In* R and D Associates Proc of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 24 p 1982 refs
Avail: NTIS HC A99/MF A01 CSCL 10B

The results of a parametric study of unmanned space nuclear reactor power systems utilizing either thermoelectric or thermionic energy converters are presented An in-core reactor design and two heat pipe cooled out-of-core reactor designs were considered One of the out-of-core designs utilized long heat pipes directly coupled to the energy converters. The second utilized a larger number of smaller heat pipes (mini-pipe) radiatively coupled to the energy converter. In all cases the entire system, including the power conditioning subsystem and its radiator, were constrained to be launched by a single shuttle. The mass and size of each system was studied as a function of several variables including: power level, lifetime, number and size of core heat pipes, fuel swelling model, reactor and heat rejection temperatures, converter type and performance level, allowable radiation dose at the payload, shadow shield cone angle, power conditioning temperature and efficiency, etc. The most critical component determining system performance is the reactor. Its design is driven by concerns for fuel swelling rate which is in turn dependent on the nature of the swelling, reactor power level, and the number and size of the heat pipes used to cool the core.
Author

**N83-15858#** Westinghouse Electric Corp , Pittsburgh, Pa. Advanced Energy Systems Div
**GAS COOLED REACTORS FOR LARGE SPACE POWER NEEDS**
G. H. PARKER *In* R and D Associates Proc. of the AFOSR Spec. Conf on Prime-Power for High Energy Space Systems, Vol 1 21 p 1982
Avail. NTIS HC A99/MF A01 CSCL 10B

Gas cooled space reactors can be built in the next few years and their performance capabilities exceed those of the power conversion systems (PCS) that the reactors will drive. For space applications requiring MW(e), the closed cycle Brayton cycle is a strong candidate for the PCS. For these high power levels, waste heat rejection to space by radiators tends to drive systems to high operating temperatures so that reasonably sized system envelope dimensions can be attained Thus, compact, high power density, high temperature, high burnup reactors will be needed. The technology base for these reactors is well established.
Author

**N83-15859#** Brookhaven National Lab., Upton, N. Y. Dept. of Nuclear Energy.
**COMPACT, HIGH-POWER NUCLEAR REACTOR SYSTEMS BASED ON SMALL DIAMETER PARTICULATE FUEL**
J. R. POWELL and T. E. BOTTS *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 5 p 1982
Avail NTIS HC A99/MF A01 CSCL 10B

Two compact, high-power nuclear reactor concepts are discussed. Both are gas-cooled cavity-type reactors which utilize particulate fuel of the type now used in HTGR reactors. Unshielded reactor volumes are on the order of one cubic meter The Fixed Bed Reactor operating temperature is limited to 2500 K and the output power to 250 MW(e). In the Rotating Bed Reactor fuel is held within a rotating porous metal drum as a rotating fluidized bed. Rotating Bed Reactor outlet temperatures up to 3000 K and output power levels up to 1000 MW(e) are achievable. Both reactors can be brought up from stand by to full power in times on the order of a few seconds, due primarily to the short thermal time constant for the fuel particles. Turbine and MHD Brayton are the power conversion cycles of choice. Open cycle operation is generally favored for applications operating at less than 1000 sec of equivalent integrated full power. At power levels above 1 MW(e), the liquid droplet radiator is the favored means of heat rejection. Power system specific power levels of 10 kW(e)/kg (not including shield) appears to be quite feasible. Author

**N83-15860#** R and D Associates, Rosslyn, Va.
**PROCEEDINGS OF THE AFOSR SPECIAL CONFERENCE ON PRIME-POWER FOR HIGH ENERGY SPACE SYSTEMS, VOLUME 2 Final Report**
P. J. TURCHI 1982 834 p refs Conf. held in Norfolk, Va., 22-25 Feb 1982 2 Vol.
(Contract F49620-82-C-0008)
(AD-A118888; AFOSR-82-0656TR-VOL-2) Avail: NTIS HC A99/MF A01 CSCL 10B

The state of the art of space prime power technology is reviewed and research needed for progress toward megawatt power levels is discussed Radiant energy techniques, materials requirements, chemical physics, thermionics, thermal management systems, and power requirements of future NASA and DOE system are addressed

**N83-15861*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A PROPOSED OPTICAL PUMPING SYSTEM REQUIRING NO ELECTRIC POWER Final Report**
B. R. PHILLIPS *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 11 p 1982
Avail: NTIS HC A99/MF A01 CSCL 20F

A method for optically pumping a fluid without electrical power is described. The method is based on utilizing the radiation from a metal oxidant combustion reaction that is contained within a transparent tube that is immersed in the medium to be pumped. The reaction initiation and maintenance occurs by gas dynamically induced resonance within the transparent cavity. All that is required is a supply of high pressure oxidant and metallic powder. Materials that were successfully evaluated to date include aluminum, steel, magnesium, and titanium. M.G.

**N83-15862#** Illinois Univ., Urbana. Fusion Studies Lab
**STATUS, RESEARCH REQUIREMENTS AND POTENTIAL APPLICATIONS FOR NUCLEAR PUMPED LASERS Final Report**
G. H. MILEY *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 30 p 1982 refs
Avail: NTIS HC A99/MF A01

Mechanisms and various approaches to nuclear pumping of lasers are reviewed. Experimental results to date (including various noble gas lasers and more recent N2-He-CO2 and O2(1 delta)-I2 transfer lasers) are briefly noted. Both physics issues (e.g., electron energy distributions) and technology issues (e.g., coatings vs. UF6 neutron interaction regions) are identified. Finally, considerations involved in potentially attractive applications such as space nuclear laser systems and neutron feedback inertial confinement fusion are outlined. M.G

**N83-15863#** Argonne National Lab., Ill.
**PRIME POWER FOR HIGH-ENERGY SPACE SYSTEMS: CERTAIN RESEARCH ISSUES Final Report**
E. W. WALBRIDGE *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol 2 10 p 1982 refs
Avail: NTIS HC A99/MF A01

The physical mechanisms underlying Alfven wave drag and induced magnetic moment effects on high energy space systems are described. An expression for the induced magnetic moment of a (ring-shaped) satellite is presented. Several other issues requiring attention are also pointed out. These include, in particular, the need to avoid a demise like that of Skylab, how to obtain high heat engine thermal efficiency, what to do about the damaging effects of Van Allen belt radiation, and the need for storing energy over long periods but having it quickly available on short notice. M.G.

**N83-15864*#** Rasor Associates, Inc., Sunnyvale, Calif.
**STATUS OF THERMOELECTRONIC LASER ENERGY CONVERSION, TELEC Final Report**
E. J. BRITT *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol 2 11 p 1982
Avail: NTIS HC A99/MF A01

A concept known as a thermo-electronic laser energy converter (TELEC), was studied as a method of converting a 10.6 micron CO2 laser beam into electric power. The calculated characteristics of a TELEC seem to be well matched to the requirements of a spacecraft laser energy conversion system. The TELEC is a high power density plasma device which absorbs an intense laser beam by inverse bremstrahlung with the plasma electrons. In the TELEC process, electromagnetic radiation is absorbed directly in the plasma electrons producing a high electron temperature. The energetic electrons diffuse out of the plasma striking two electrodes which are in contact with the plasma at the boundaries. These two electrodes have different areas: the larger one is designated as the collector, the smaller one is designated as the emitter. The smaller electrode functions as an electron emitter provide continuity of the current. Waste heat is rejected from the collector electrode. An experiment was carried out with a high power laser using a cesium vapor TELEC cell with 30 cm active length. Laser supported plasma were produced in the TELEC device during a number of laser runs over a period of several days. Electric power from the TELEC was observed with currents in the range of several amperes and output potentials of less than 1 volt. M.G

**N83-15866*#** Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
**THE PHOTOTRON: A LIGHT TO RF ENERGY CONVERSION DEVICE Final Report**
J. W. FREEMAN and S. SIMONS *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 17 p 1982 refs
(Contract NAG3-29)
Avail: NTIS HC A99/MF A01

The phototron, a photoelectric device that converts light to radio frequency energy, is described. It is a vacuum tube, free electron, device that is mechanically similar to a reflex klystron with the hot filament cathode replaced by a large area photocathode. The device can operate either with an external voltage source used to accelerate the photoelectrons or with zero bias voltage; in which case the photokinetic energy of the electrons sustains the R.F. oscillations in the tuned R.F. circuit. One basic design of the phototron was tested. Frequencies as high as about 1 GHz and an overall efficiency of about 1% in the biased mode were obtained. In the unbiased mode, the frequencies of operation

and efficiences are considerably lower. Success with test model suggests that considerable improvements are possible through design refinements. One such design refinement is the reduction of the length of the electron flight path. M.G.

**N83-15867*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**RADIATION-DRIVEN MHD SYSTEMS FOR SPACE APPLICATIONS Final Report**
J. H. LEE (Vanderbilt Univ.) and N. W. JALUFKA *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 11 p 1982 refs
Avail: NTIS HC A99/MF A01

High-power radiation such as concentrated solar or high-power laser radiation is considered as a driver for magnetohydrodynamic (MHD) systems which could be developed for efficient power generation and propulsion in space. Eight different systems are conceivable since the MHD systems can be classified in two: plasma and liquid-metal MHD's. Each of these systems is reviewed and solar- (or laser-) driven MHD thrusters are proposed. Author

**N83-15869#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OVERVIEW OF HIGH-TEMPERATURE MATERIALS FOR HIGH-ENERGY SPACE POWER SYSTEMS Final Report**
N. T. SAUNDERS *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 39 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10B

The current state of technology and some of the more pressing research needs and challenges associated with the possible use of high temperature materials in future high energy space power systems are discussed. Particularly, emphasis is on the need to improve and quantify the fundamental understanding of the effects of the following: (1) fast neutron radiation on the properties and behavior of nuclear reactor fuels and claddings; and (2) long term, high temperature, space (vacuum) exposure on the properties of refractory metals considered for use as structural materials in various power conversion systems. M.G.

**N83-15871#** General Atomic Co., San Diego, Calif.
**NUCLEAR FUEL SYSTEMS FOR SPACE POWER APPLICATION Final Report**
L. YANG *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 26 p 1982 refs
Avail: NTIS HC A99/MF A01

Work carried out on in-core thermionic fuel-cladding development has indicated that the uranium carbide-tungsten and the uranium oxide-tungsten fuel systems are promising candidates. Materials and fabrication techniques were developed to meet the requirements of the thermionic fuel elements. Out-of-pile and in-pile studies of fuel-cladding compatibility, dimensional stability, and thermionic performance stability were performed for both fuel systems. Accelerated irradiation tests attained a burnup of 3 x 10 to the 20th power fissions/cu cm for the carbide and the oxide fueled emitters at 1900 K, which is equivalent to that for 40,000 hours of operation of 120 ekw thermionic reactor. Prototypical carbide and oxide fueled emitters were tested for 8000 hours at 1740 to 1840 K. Comparatively speaking, the carbide-fueled system exhibited greater dimensional stability than the oxide-fueled system, while the oxide-fueled system exhibited better thermionic performance stability than the carbide-fueled system. The experiences gained in the development of coated fuel particles for the high temperature, gas-cooled reactor are described and the potential of such coated fuel particles for space power application is discussed. M.G.

**N83-15872#** Westinghouse Research and Development Center, Pittsburgh, Pa.
**MATERIALS FOR HIGH POWER MHD SYSTEMS Final Report**
B. R. ROSSING *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol 2 19 p 1982 refs
Avail: NTIS HC A99/MF A01

Electrode and insulator materials requirements for high power magnetohydrodynamic power generators are discussed. Open and closed cycle linear generators are emphasized. Author

**N83-15874#** Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
**APPLICATIONS OF A HIGH TEMPERATURE RADIATION RESISTANT ELECTRICAL INSULATION Final Report**
M. H. COOPER *In* R and D Associates Proc of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol 2 16 p 1982 refs
Avail: NTIS HC A99/MF A01

Electrical camponents are being developed for service inside the reactor vessel of Fast Breeder Reactors. These components will function in an exceptionally hostile environment combining high temperature (1000 F), chemical activity (liquid sodium), and nuclear radiation (fast neutron fluences to 1021 n/sq cm). Two components which are being developed are an electromagnetically actuated shutdown system and an induction motor. The successful development of a glass-alumina insulation which is suitable for operation at high temperature and in high radiation fields is the key technological advance that has resulted in the development of these components. The insulation is applied by a dipping process similar to conventional enamel insulation utilizing a slurry of glass-alumina in an organic binder. Drying at modest temperature results in a green flexible coating that is adherent to the wire. After the wire is formed into the desired component, the wire is fired at high temperature to eliminate the binder and to fuse the glass mixture to the wire. Electromagnetic coils thus fabricated have been operated for more than 18 months in sodium systems from 850 to 1100 F. Author

**N83-15878#** Spire Corp., Bedford, Mass.
**APPLICATIONS OF MATERIALS SURFACE MODIFICATION TO PRIME POWER SYSTEMS Final Report**
F. L. MILDER *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 14 p 1982 refs
Avail: NTIS HC A99/MF A01

The new technologies of surface modification are ideally suited for space applications. Surface modification offers the ability of custom creating materials with one set of surface properties conjoined to a dissimilar or even mutually exclusive set of bulk properties. The benefit of such specifically engineered materials is an efficiency in component design which translates to weight minimization. Modern surface modification techniques, including ion implantation, sputter deposition, and plasma/ion deposition, deal with thin film layers in the range from a few nanometers to a few micrometers. Ion implantation is unique in that it forcibly injects an element of choice into the near surface region of a material. Thus, alloys or solid solutions are formed unaccompanied by dimensional changes. The numerous and varied deposition techniques, on the other hand, grow coating layers, often with unique properties. B.W.

**N83-15886#** General Atomic Co., San Diego, Calif.
**THERMIONIC CONVERSION FOR SPACE POWER APPLICATION Final Report**
L. YANG and G. O. FITZPATRICK *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 16 p 1982 refs Prepared in cooperation with Rasor Associates, Inc., Sunnyvale, Calif.
Avail: NTIS HC A99/MF A01

Efforts to develop thermionic conversion for space power application are discussed. Tungsten, niobium and Al2O3 were selected as the emitter, collect and insulator materials for the

converter. Uranium carbides and uranium oxide were selected as candidates for the nuclear fuel A total of 36 fueled thermionic converters and fuel elements were life-tested during 1965 to 1972. These tests, supported by a dozen converter tests and several material irradiation tests, provided the base of the in-core thermionic technology. Unfueled converters demonstrated a life of five years or more, while fueled converter fuel elements have been operated for one to one and one-half years. The major limiting factors for converter life and performance were: component diffusion through cladding and emitter cracking for carbide-fueled converters, and emitter swelling for the oxide-fuel converters. Various means for mitigating the fuel effects on converter life and performance were proposed but they were not thoroughly evaluated R.J.F.

**N83-15887#** Thermo Electron Corp , Waltham, Mass.
**THERMIONIC TECHNOLOGY FOR SPACECRAFT POWER: PROGRESS AND PROBLEMS Final Report**
F. HUFFMAN, D. LIEB, P. REAGAN, and G MISKOLCZY *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol 2 30 p 1982 refs
Avail: NTIS HC A99/MF A01

Thermionic conversion for use with space reactors is discussed. Advantages are discussed, as well as development problems. The mechanical simplicity associated with no moving parts implies reliability. The high temperature of heat rejection minimizes the mass of the radiator - which is usually the heaviest component of large space power systems. The high heat rejection temperature also limits the size of the radiator, which is an important consideration, since all space reactor systems in the foreseeable future must fit inside the space shuttle bay. Modularity maximizes reliability by eliminating single point system failures. In addition, thermionics is a demonstrated conversion technology coupled to nuclear reactors. Although available thermionic converter performance yields systems with attractive specific masses of around 20 kG/kWe, higher efficiency and power density are certainly desirable. For space systems, this improvement must accrue from reduced potential losses in the interelectrode plasma since the radiator temperature will be too high to take advantage of collector work functions lower than those already available.
R.J.F

**N83-15888#** Carnegie-Mellon Univ., Pittsburgh, Pa.
**A SURVEY OF RECENT ADVANCES IN AND FUTURE PROSPECTS FOR THERMIONIC ENERGY CONVERSION Final Report**
J. LAWLESS *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 2 8 p 1982
Avail: NTIS HC A99/MF A01

Some powerful advances in the fundamental understanding of Thermionic Conversion are discussed. Those include numerical computer simulations and simple analytical models. As a consequence of these advances, many new ideas are being developed with the potential for major improvements in thermionic converter performance. In particular, structured electrodes and oscillation effects now show strong possibilities for important improvements. Further, modeling techniques now exist to consider pore converters and third electrode converters in detail whereas past studies were mainly empirical. In summary, greatly superior performance can be expected from future thermionic converters.
R.J.F.

**N83-15889#** Grumman Aerospace Corp., Bethpage, N.Y.
**THERMAL MANAGEMENT OF LARGE PULSED POWER SYSTEMS Final Report**
B. HASLETT *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 36 p 1982 refs
Avail: NTIS HC A99/MF A01

Current thermal control technology is reviewed and limitations assessed compared to a typical high pulse power application. Thermal management is a significant weight factor (approximately 50%) of even medium power systems which points to a large potential payback from innovative techniques. Thermal research is recommended in the areas of concentrating and thermovoltaic solar arrays, two phase heat transport loops, direct contact heat exchangers and advanced radiator systems. Air Force space power trends indicate requirements for systems with 10 to 200 KW average power with pulse/average power ratios of 10/1 to 1000/1. Thermal system definition is complicated by the variety of possible power systems although solar and nuclear (Brayton and Thermionic) appear to be the leading candidates. R.J.F.

**N83-15893#** Thermacore, Inc., Lancaster, Pa.
**ENHANCED HEAT PIPE THEORY AND OPERATION Final Report**
D. M. ERNST and G. Y EASTMAN *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 2 24 p 1982
Avail: NTIS HC A99/MF A01

Heat pipes to extract heat from the cores of compact fast reactors are discussed. They require unusually high power densities. This performance appears to be feasible, but necessitates more detailed exploration of theoretical and operational limits than has then carried out to date. Closely aligned to heat pipes for heat removal from the core are the low mass high performance, high temperature radiator heat pipes The areas requiring the greatest attention are the startup and shutdown characteristics of long heat pipes, the limits on wick augmented thin film evaporation (burn out heat flux) and the prediction of the true temperature profile along the heat pipe. It will also almost certainly require exploration and analysis of higher capacity capillary wicks. R.J F.

**N83-15895#** Little (Arthur D ), Inc , Cambridge, Mass.
**LIQUID RIBBON RADIATOR FOR LIGHTWEIGHT SPACE RADIATOR SYSTEMS Final Report**
W P TEAGAN *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 2 13 p 1982
Avail: NTIS HC A99/MF A01

The liquid metal ribbon (CMR) radiator concept described operates by forming a thin (10-100 micrometers) liquid metal meniscus on a wide mesh screen structure which is drawn through space by a retractable pulley system. The liquid metal bath from which the liquid metal ribbon is formed can be a heat dissipation sink for a spaceborne power system or space thermal control system Preliminary analysis indicates that radiators formed in this way show promise of achieving weights one tenth to one fourth those of conventional space radiators utilizing heat pipe configurations. Film materials which have been combined include gallium, tin, and lithium. These materials cover a wide range of potential heat rejection temperature needs. Author

**N83-15898#** Layton (J. Preston), Princeton Junction, N.J.
**POWER CONVERSION: OVERVIEW Final Report**
J. P. LAYTON *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol 2 23 p 1982 refs
Avail: NTIS HC A99/MF A01

The central position of power conversion systems in relation to other elements of space power systems is identified and the recognized types of power conversion are shown to be: photovoltaic, thermoelectric, Brayton cycle, Rankine cycle, Stirling cycle, thermionic and electromagnetic. The requirement for space electric power levels versus calendar years are presented historically and projected beyond the turn of the century. A number of space power systems that may employ thermoelectric, Brayton, Rankine and magnetohydrodynamic power conversion are illustrated and discussed. The need for mission and systems analyses to support the identification of applied research in power conversion is argued and the approach for conducting these analyses is presented. Author

**N83-15900#** Power Conversion, Inc., Elmwood, N J.
**PRIMARY LITHIUM ORGANIC ELECTROLYTE BATTERY BA-5588 Final Report, Apr. 1979 - Jan. 1981**
M. G. ROSANSKY *Jul* 1982 101 p *refs*
(Contract DAAK20-79-C-0260)
(AD-A120858; DELET-TR-79-0260-F) Avail: NTIS HC A06/MF A01 CSCL 10C

This program concerns the development, fabrication and evaluation of a Lithium organic electrolyte battery designated BA-5588 ()/U which incorporates five series connected, hermetically sealed cells housed in a plastic case. Significant effort was directed towards cell optimization through controlled experimentation and evaluation of various design parameters. Demonstration of the effectiveness of the finalized design was accomplished by the performance of various electrical and abuse tests which included environmental exposure, prolonged thermal storage, electrical discharge under various thermal profiles, short circuit and discharge to zero volts as well as forced discharge. The resulting evaluation demonstrated the batteries ability to operate safely under all of the specified abusive environments and provide 100% of the specified service life requirements
Author (GRA)

**N83-15901#** Gould, Inc., Rolling Meadows, Ill. Materials Lab.
**STUDIES LEADING TO THE DEVELOPMENT OF HIGH-RATE LITHIUM-SULFURYL CHLORIDE BATTERY TECHNOLOGY Quarterly Report, 1 Apr. - 30 Jun. 1982**
J. C. HALL and M. KOCH Oct. 1982 50 p
(Contract DAAK20-81-C-0420, DA PROJ. 1L1-62705-AH-94)
(AD-A120853; DELET-TR-81-0420-3; QR-3) Avail NTIS HC A04/MF A01 CSCL 10C

The overall aim of the program is an examination of the viability of an active electrolyte lithium-sulfuryl chloride battery system. The specific objectives are· quantify the stability of lithium in sulfuryl-chloride based electrolyte. Develop means to stabilize in the lithium anode in sulfuryl chloride based electrolyte to meet Army storage requirements. Establish the performance limits of Li/SO2Cl2 cells with respect to cathode and electrolyte composition GRA

**N83-15903#** Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
**PRELIMINARY ANALYSIS OF WAVE ENERGY CONVERSION AT AN OFFSHORE STRUCTURE Final Report**
A. D. CARMICHAEL, D. ASSANIS, and J. O. SALSICH Sep. 1982 55 p refs
(Contract MIPR-Z-700999-1-00886)
(AD-A120079; USCG-D-65-81) Avail: NTIS HC A04/MF A01 CSCL 10A

A study of the feasibility of utilizing wave energy to provide the electrical power to operate the Buzzards Bay Light Tower has been carried out It was concluded that a pneumatic buoy attached to the light tower would be the best solution. Experiments were conducted in the MIT Towing Tank to estimate the performance of such a device The loads imposed by the wave energy device on the power during an extreme storm were estimated and were predicted to be very large. Theoretical and experimental studies have indicated a possible method of reducing the size of the wave energy device by controlling the air pressure in the buoy.
Author (GRA)

**N83-15907#** National Academy of Sciences - National Research Council, Washington, D. C Committee on Offshore Energy Technology.
**STUDIES LEADING TO THE DEVELOPMENT OF HIGH-RATE LITHIUM SULFURYL CHLORIDE BATTERY TECHNOLOGY Quarterly Report, 1 Jan. - 31 Mar. 1982**
J C. HALL and M. KOCH Sep 1982 58 p refs
(Contract DAAK20-81-C-0420; DA PROJ. 1L1-62705-AH-94)
(AD-A120002, DELET-TR-81-0420-2; QR-2) Avail: NTIS HC A04/MF A01 CSCL 10C

The overall aim of the program is an examination of the viability of an active electrolyte lithium sulfuryl chloride battery system. The specific objectives are: (1) quantify the stability of lithium in sulfuryl chloride solution; (2) explore means to stabilize lithium in sIfuryl chloride; (3) establish the limits of performance of carbon/teflon cathodes. During the second quarter we: continued characterization of anode stability with respect to cell design and electrolyte composition, determined the voltage delay after storage as a function of electrolyte composition, and characterized the performance at room temperatures of cells with and without performance additives. We found that positive grounding or floating of both electrodes with respect to the case enhance anode stability, the bromine performance additive increases anode stability, the bromine performance additive decrease voltage delay, and the bromine performance additive is superior to the chlorine performance additive in terms of delivered capacity. GRA

**N83-15908#** Midwest Research Inst., Golden, Colo. Solar Energy Research Inst
**FIFTH BIENNIAL WIND ENERGY CONFERENCE AND WORKSHOP (WW5)**
I. E. VAS, ed (Flow Industries, Inc.) 1981 539 p refs Conf. held in Washington, D.C., 5-7 Oct. 1981 Sponsored by DOE
(DE82-014659, SERI/CP-635-1340-VOL-1; CONF-811043-VOL-1)
Avail· NTIS HC A23/MF A01

Wind energy programs are reviewed. Results of research and development studies were presented in the areas of wind turbine technology, applications, economics, environmental, performance and wind resource. Analysis and improvements to the state of the art are discussed.

**N83-15909#** Department of Energy, Washington, D. C. Wind Energy Technology Div.
**THE FEDERAL WIND ENERGY PROGRAM**
L. V. DIVONE *In* Midwest Res. Inst. Fifth Bien Wind Energy Conf. and Workshop (WW5) p 3-26 1981
Avail: NTIS HC A23/MF A01

The utilization and development of wind energy systems are reviewed. The future of these systems is discussed. S L

**N83-15911*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE NASA LEWIS LARGE WIND TURBINE PROGRAM**
R. L. THOMAS and D. H BALDWIN *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf and Workshop (WW5) p 39-58 1981 refs
Avail: NTIS HC A23/MF A01 CSCL 10A

The large wind turbine program activities are reviewed. These activities include results from the first and second generation field machines (Mod-OA, 1, and 2), the design phase of the third generation wind turbine (Mod-5) and the advanced technology projects. The status of the WTS-4 machine is also presented.
S.L

**N83-15912#** Rockwell International Corp , Golden, Colo. Energy Systems Group.
**ROCKY FLATS SMALL WIND SYSTEMS PROGRAM: AN UPDATE**
T J. HEALY and D. M. DODGE *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 59-70 1981
Avail: NTIS HC A23/MF A01

A test center for small wind systems developed at Rocky Flats. This center is now fully established with a complete range of system and component test capabilities. Over 25 commercially available machines were tested. The first of 14 systems development subcontracts was issued to private industry Twelve prototypes resulting from these subcontracts are now fabricated and under evaluation Some prototypes have undergone extensive engineering refinement and several are now on the market A range of activities - including a nationwide field evaluation program - which addressed institutional barriers to small wind systems use was initiated. These activites greatly increased national awareness of small wind systems potential and provided valuable information on wind systems applications, financial and product liability issues, regulatory issues and other subjects. This information is helping

utilities, government agencies and various institutions incorporate small wind systems in the existing power production, financial and regulatory environment. S.L.

**N83-15913#** Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
**VERTICAL AXIS WIND TURBINE PROGRAM**
R. H. BRAASCH *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 71-85 1981 refs
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A23/MF A01

Research investigations suggest that reduction in cost of energy (COE) and increases in reliability for VAWT systems are possible through changes in aerodynamic design The basic changes desired are: (1) lower cut-in windspeed, (2) increase maximum efficiency, (3) limit maximum aerodynamic power, (4) limit peak aerodynamic torque, and (5) increase rotor rotational speed. Several basic aerodynamic experiments (2) are conducted to better understand the aerodynamics of a section operating in an unsteady, curvilinear flowfield. The experiments include blade chordwise pressure distribution and acceleration surveys, the use of blade sections designed to operate specifically in the VAWT environment (laminar flow profile), blade blowing (boundary layer control), blade cambering, and blade offset/preset pitch (incidence). S.L.

**N83-15914#** Department of Agriculture, College Station, Calif. Agricultural Research Service.
**THE USDA AGRICULTURAL WIND ENERGY RESEARCH PROGRAM**
R. N. CLARK *In* Midwest Res. Inst. Fifth Bien Wind Energy Conf. and Workshop (WW5) p 85-92 1981 refs
Avail: NTIS HC A23/MF A01

Applications of wind power in agriculture were investigated. Building heating projects were conducted using a 15-kW electrical machine to power resistant heaters, and a 4-kW cycloturbine powered a water churn to heat water. The two projects in product storage and processing provided refrigeration for short and long term storage systems. Milk was cooled at a dairy and exhaust heat from the compressor was used to preheat the hot water. In the other project, apples were cooled and stored for six months. The apple storage system incorporated an ice bank for storage during nonwind periods. The two irrigation experiments involved pumping water from a surface reuse system using a vertical axis wind turbine directly coupled to a turbine pump and wind assist pumping from a deep well by combining a wind turbine with a diesel engine. The wind assist concept saved 40% of fuel normally used in pumping the well. Economic analyses of these applications show that most individual loads on a farm are usually too short in duration to make the unit profitable. S.L.

**N83-15916*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**OPERATING EXPERIENCE WITH THE 200 KW MOD-OA WIND TURBINE GENERATORS**
A. G. BIRCHENOUGH, A. L. SAUNDERS, T. W. NYLAND, and R. K. SHALTENS *In* Midwest Res. Inst. Fifth Bien Wind Energy Conf. and Workshop (WW5) p 107-118 1981 refs
Avail: NTIS HC A23/MF A01 CSCL 10A

The machine configuration and its advantages and disadvantages, particularly as it affects reliability are discussed. The machine performance, both availability and power output characteristics are described. The Mod-OA operational experience is documented. The characteristics of the wind energy generated, the machine performance, and the subsystem strengths and weaknesses are discussed. An assessment of the project success in fulfilling its goals and objectives is also presented. S.L.

**N83-15917#** WTG Energy Systems, Inc., Buffalo, N.Y.
**OPERATIONAL EXPERIENCE ON MP-200 SERIES COMMERCIAL WIND TURBINE GENERATORS**
M. ROSE *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 119-124 1981 refs
Avail: NTIS HC A23/MF A01

Innovations in the areas of blade design, corrosion resistance, control philosophies and the design of critical shutdown mechanisms are discussed. A periodic variation of output power encountered on the MP2-200 and MP3-200, and a proposed solution for these oscillations are also discussed. S.L

**N83-15918#** Boeing Engineering and Construction Co., Tukwila, Wash.
**TEST STATUS AND EXPERIENCE WITH THE 7.5 MEGAWATT MOD-2 WIND TURBINE CLUSTER**
R. A. AXELL and H. B. WOODY *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 143-156 1981
Avail: NTIS HC A23/MF A01

The Mod-2 wind turbine cluster is described. The site preparation and construction activities are discussed, and preliminary test results, status, and plans are presented. S.L.

**N83-15919#** General Electric Co., Philadelphia, Pa. Advanced Energy Programs Dept.
**CONCEPTUAL DESIGN OF THE 6 MW MOD-5A WIND TURBINE GENERATOR**
R. S. BARTON and W C. LUCAS *In* Midwest Res. Inst Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 157-168 1981
Avail: NTIS HC A23/MF A01

The MOD-5A wind turbine system must generate electricity for 3.75 c/KWH (1980) or less. During the conceptual design phase, the MOD-5A WTC system size and features were established as a result of tradeoff and optimization studies driven by minimizing the system cost of energy (COE). This led to a 400' rotor diameter size. The MCD-5A system which resulted is defined along with the operational and environmental factors that drive various portions of the design Development of weight and cost estimating relationships and their use in optimizing the MOD-5A are discussed. The results of major tradeoff studies are also presented. Subsystem COE contributions for the 100th unit are shown along with the method of computation. The major subsystems are described in order that the results of the various trade and optimization studies can be more readily visualized S.L.

**N83-15920#** Boeing Engineering and Construction Co., Seattle, Wash.
**CONCEPTUAL DESIGN OF THE 7 MEGAWATT MOD-5B WIND TURBINE GENERATOR**
R. R. DOUGLAS *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 169-181 1981 refs
Avail: NTIS HC A23/MF A01

Similar to MOD-2, the MOD-5B wind turbine generator system is designed for the sole purpose of providing electrical power for distribution by a major utility network. The cost of electricity (COE) target is reduced from 4c/Kwhr on MOD-2 to 3c/Kwhr on MOD-5B. The MOD-5B concept studies and eventual concept studies and eventual concept selection confirmed that the program COE targets could not only be achieved but substantially bettered. Starting from the established MOD-2 technology as a base, this achievement resulted from a combination of concept changes, size changes, and design refinements. The result of this effort is a wind turbine system that can compete with conventional power generation over significant geographical areas, increasing commercial market potential by an order of magnitude. S.L.

**N83-15921#** Hamilton Standard, Windsor Locks, Conn. Wind Energy Systems Dept.
**STATUS OF THE 4 MW WTS-4 WIND TURBINE**
R J. BUSSOLARI *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 183-192 1981
Avail: NTIS HC A23/MF A01

The WTS-4 is a four megawatt, horizontal axis wind turbine. The specifications, characteristics and features of the WTS-4 are discussed. The major component such as rotor, nacelle and tower are described and their status in the fabrication phase is presented. S.L.

**N83-15925#** Kaman Aerospace Corp , Bloomfield, Conn
**THE 40 KW INTERMEDIATE SWECS PROGRAM**
B. A. GOODALE *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 271-282 1981
Avail: NTIS HC A23/MF A01

A horizontal axis wind turbine rated at 40 kW at 9 m/s is discussed. The system has a 19.5 m (64 ft.) diameter rotor with two fiberglass blades mounted downwind of the tower at a hub height of 23 m (75 ft). To accommodate various output configurations, a variable pitch rotor with a microprocessor controller is incorporated. The prototype is now under test The system is briefly described and the test program and results to date are discussed Some of the development problems encountered and corrected are discussed The approach to commercialization of such a system is discussed, as are some of the changes to the machine considered necessary for production. R.J.F.

**N83-15926#** Riso National Lab., Roskilde (Denmark). Test Plant for Small Windmills.
**ON THE POWER REGULATION OF SMALL WIND TURBINES BASED ON EXPERIENCE WITH SMALL DANISH WIND TURBINES**
P. LUNDSAGER *In* Midwest Res. Inst. Fifth Bien Wind Energy Conf and Workshop (WW5) p 285-296 1981 refs
Avail: NTIS HC A23/MF A01

The state of development of the small wind turbines on the Danish market covering a range of 10 to 55 kW, of which approximately 500 are in operation is discussed. A typical feature of Danish small wind turbines is the regulation of the power output by stalling of the rotor blades. The merits of the stall regulation are discussed with respect to both power regulation and structural design and safety. The characteristic benefits and problems are discussed in some detail and compared to those of the pitch regulation. A survey of problems in both methods to be solved by research and development work in the next few years is given R.J.F.

**N83-15927#** National Taiwan Univ., Taipei.
**THE WIND PROGRAM IN A TYPHOON ENVIRONMENT**
Y S. TSAO *In* Midwest Res Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 297-304 1981
Avail: NTIS HC A23/MF A01

The present wind program in the Republic of China (including Taiwan and the off-shore islands under ROC control) is discussed. The collection of wind data in hopeful windmill sites, especially those on offshore islands and coastal areas is discussed. The installation of experimental small wind machines in the above-mentioned sites is described. For example, some small machines will be set up this year in Quemoy for pumping of irrigation water while others will be used for salt-making in the Southern Coast of Taiwan. An evaluation of available Wind energy in Taiwan is given. The assessment of the effect of typhoon on the safety, cost and operation of wind machines is discussed R.J.F.

**N83-15928#** Aluminum Co. of America, Alcoa Center, Pa.
**ALCOA ALVAWT PROGRAM**
F. M. TOWNSEND and R. J. FALKENBERG *In* Midwest Res Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 311-330 1981
Avail: NTIS HC A23/MF A01

A review of the failure of wind turbines is given Data from strip-chart recordings are analyzed. Numerous conclusions are drawn regarding various points of system breakdown. It is also concluded that neither the 17 meter nor the 500 kW will be ready for commercialization without another prototype of each R.J F

**N83-15929#** National Research Council of Canada, Ottawa (Ontario).
**MEASUREMENTS ON THE MAGDALEN ISLANDS VAWT AND FUTURE PROJECTS**
R. J TEMPLIN and R. S RANGI *In* Midwest Res Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 331-344 1981 refs
Avail: NTIS HC A23/MF A01

The rotor of a 224 kW vertical axis wind turbine (VAWT) is discussed. The rebuilt rotor of the 224 kW Magdalen Islands VAWT was installed in Sept. 1979 and is operating at its design speed (36.6 rpm). Agreement between measured and theoretical performance is generally good except that maximum power may exceed theoretical predictions. Measurements of drive train losses, torque and power ripple, and rotor stresses are discussed. Although peak-to-peak cyclic stress levels are low in relation to fatigue life limits, spectral analysis of stress data indicates that the 3-per-rev component is amplified by near-resonance with the first butterfly blade mode. This resonance was subsequently de-coupled by a damped connection between the blade struts and the central column R.J.F.

**N83-15930#** DAF Indal Ltd., Mississauga (Ontario).
**REVIEW OF DAF INDAL VAWT COMMERCIALIZATION PROGRAMS**
C. F. WOOD, L. A. SCHIENBEIN, and D. J. MALCOLM *In* Midwest Res. Inst. Fifth Bien Wind Energy Conf. and Workshop (WW5) p 345-356 1981 refs Sponsored in part by the National Research Council of Canada
Avail. NTIS HC A23/MF A01

Commercialization efforts aimed at improvements in the design and manufacture of vertical axis wind turbines (VAWT) are discussed. The development and testing of a wind assisted diesel generator system is discussed. Improvements in the design of a 50 kW VAWT is discussed The design of a 375 kW system is also discussed. A feasibility study to identify the most cost effective VAWT turbine size is discussed R.J.F.

**N83-15931#** Sandia Labs., Albuquerque, N Mex. Advanced Energy Project Div
**STATUS REPORT OF THE 17-M VAWT PROGRAM**
R. O. NELLUMS *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 359-370 1981 refs
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A23/MF A01

Two 17 meter, 100 kW vertical axis wind turbines are discussed. Specifications are given. Production costs are discussed, including hours of labor for various parts. Results of certification tests are given. The structural status of the VAWT's is discussed, with emphasis upon drive train and rotor stresses. R.J.F.

**N83-15932#** Sandia Labs., Albuquerque, N. Mex. Advanced Energy Projects Div.
**STRUCTURAL DYNAMIC RESPONSE CHARACTERISTICS OF DARRIEUS VERTICAL AXIS WIND TURBINES**
W. N. SULLIVAN *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 371-384 1981 refs
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A23/MF A01

A brief summary of the efforts now underway in the area of the structural dynamics of vertical axis wind turbines is given The

emphasis is on discussing the status of analytical tools, the quantity and quality of existing experimental confirmation data, and the implications structural dynamic issues have on rotor design. R.J F.

**N83-15933#** Sandia Labs., Albuquerque, N Mex. Advanced Energy Projects Div.

**AERODYNAMICS AND PERFORMANCE TESTING OF THE VAWT**

P. C. KLIMAS *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 385-396 1981 refs
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A23/MF A01

The aerodynamics and testing of vertical axis wind turbines are discussed. Experiments designed to both better understand the aerodynamics of a section operating in an unsteady, curvilinear flowfield and achieve some of the desired changes in section properties are discussed. The common goal of all of these experiments is to increase efficiency an system reliability. R J F.

**N83-15934#** Midwest Research Inst., Golden, Colo Solar Energy Research Inst.

**TELEVISION INTERFERENCE AND ACOUSTIC EMISSIONS ASSOCIATED WITH THE OPERATION OF THE DARRIEUS VAWT**

N. D. KELLEY, R R HEMPHILL, and D L SENGUPTA (Michigan Univ.) *In its* Fifth Bien Wind Energy Conf and Workshop (WW5) p 397-410 1981 refs Sponsored in part by the National Research Council of Canada and Hydro-Quebec
(Contract EG-77-C-01-4042)
Avail: NTIS HC A23/MF A01

Field surveys were conducted to assess the community annoyance potential from electromagnetic interference to television reception (TVI) and acoustic emissions associated with the operation of a Darrieus-type, vertical axis wind turbine (VAWT). The type and extent of interference to nearby television reception was evaluated using a 17 meter VAWT. A series of measurements of observed interference levels were made at a number of sites in the turbine vicinity employing the locally available VHF and UHF television signals as sources A simple theoretical model was developed for analyzing the TVI produced by the Darrieus turbine. Using this model in conjunction with the field measurements, it was found the Darrieus/VAWT produces the same amount of interference on the lower VHF channels as a horizontal axis turbine with a comparably sized blade scattering area, but less on all other channels R.J.F.

**N83-15935#** Aeronautical Research Inst. of Sweden, Stockholm.

**SOME INNOVATIVE CONCEPTS IN WIND TURBINES OF THE AXIAL-FLOW, CROSS-FLOW, AND COMBINED (DUAL) FLOW TYPES**

O. LJUNGSTROEM *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf and Workshop (WW5) p 415-432 1981 refs
Avail: NTIS HC A23/MF A01

Within the Axial-Flow Turbine (AFT) category, two concepts are described: the Swept-Blade Turbine (SWBT) and the Catenary-Ribbon Blade Turbine (CRBT). Augmentation of turbine mass flow and power output by increasing the effective sweep area (captured streamtube area) of AFT can be achieved by moving the rotor hub. Some conepts and initial exploratory experiments are described. Among concepts within the Cross-Flow Turbine (CFT) category described are: New applications of the LDB-concept(L-blade and Double Blade) to straight bladed CFT-VAWTS (e g Musgrove turbine, Giromill), Inclined shaft CFT with single and multiple shafts, Spiral Blade Concept, Fluid Ring Bearing VAWT. Further, some Dual-Flow Turbine concepts (DFT) are discussed. These consist of a large primary turbine (AFT or CFT) catching the wind energy and transferring it directly to a much smaller secondary turbine (or Brake-Turbine,BT) with high rpm, mounted on the primary turbine. Among alternatives discussed are primary AFT And CFT in combination with secondary AFT and CFT. Author

**N83-15936#** Dayton Univ., Ohio. Research Inst.

**AN UPDATE OF THE ELECTROFLUID DYNAMICS WIND DRIVEN GENERATORS**

J. E. MINARDI and M. O. LAWSON *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf and Workshop (WW5) p 433-444 1981 refs
(Contract EG-77-C-01-4042)
Avail: NTIS HC A23/MF A01

The general objective of the overall research program is to conduct research toward the development of Electrofluid Dynamic (EFD) wind driven generators. In such generators, the wind blows through suitably oriented arrays of electrodes; transports charged particles against an electrical potential gradient; and thereby generates electrical power directly without moving parts. This promises a simpler, less expensive system, free of frontal area and velocity limitations of conventional rotating wind energy systems. For the EFD wind driven generator there are no fundamental reasons to restrict the size; therefore, economies of scale can be realized. A theory for the behavior and performance of EFD wind driven generators was developed. The principle remaining problem is the development of energy economic charged droplet production Author

**N83-15937#** Reading Univ. (England).

**RECENT PROGRESS IN THE DEVELOPMENT OF THE MUSGROVE VERTICAL AXIS WIND TURBINE**

P J. MUSGROVE and I. D. MAYS (Sir Robert McAlpine and Sons Ltd.) *In* Midwest Res. Inst. Fifth Bien Wind Energy Conf. and Workshop (WW5) p 445-456 1981 refs Sponsored in part by U K Science Research Council, U.K. DOE and UKAEA
Avail NTIS HC A23/MF A01

The design of a 25 metre diameter test bed machine is described. It represents a one-quarter scale model of a 100 metre diameter, 4.4 MW rated machine suitable for use in offshore arrays, and the requirement for long life with low maintenance in a marine environment has strongly influenced the design. Economic studies of offshore wind energy systems indicated that the optimum rotor diameter may be well in excess of 100 metres. Vertical axis wind turbines avoid the cyclically varying gravity loads which limit the size of horizontal axis wind turbines, and it is anticipated that subsequent development of the Musgrove wind turbine will extend to units substantially larger than 100 metres diameter. Author

**N83-15938#** Washington Univ , St. Louis, Mo.

**ATMOSPHERIC TESTING OF A TWO BLADED FURL CONTROLLED WIND TURBINE WITH PASSIVE CYCLIC PITCH VARIATION**

K. H. HOHENEMSER and A. H. P. SWIFT *In* Midwest Res. Inst Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 457-468 1981 refs
Avail: NTIS HC A23/MF A01

Passive cyclic pitch variation, adopted from rotorcraft technology, was achieved by letting the blade pair freely oscillate about a common pivot with which the blades formed a small prelag angle. This simple two-bladed rotor was found to be capable of rapid yaw rates suitable for rotor speed control by yawing, without imposing vibratory hub moments and without producing appreciable out-of-plane blade excursions. During the first phase of testing in 1980 the 7.6 m diameter rotor was automatically furled when 228 rpm at 10 kW rotor power was exceeded Unfurling was performed manually. During the second phase of testing begun in March, 1981, fully automatic furl control systems were used which limited rotor speed and torque quite accurately to predetermined values. It was found that passive cyclic pitch variation and the associated rapid wind direction following did not degrade and possibly enhanced aerodynamic efficiency. Author

**N83-15939#** Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
**ECONOMICS OF DAWT WIND ENERGY SYSTEMS**
K M FOREMAN *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 469-486 1981 refs
Avail: NTIS HC A23/MF A01

The results of a (DAWT) preliminary design investigation to assess the economic viability of its electrical energy generation are presented. Unit costs are estimated for three output ratings and for three different construction approaches. A limited production run of 100 to 500 units is considered for factory-built subassemblies and on-site final assembly and erection. Regional production centers are assumed within about 350 km (217 miles) of installation. Author

**N83-15940#** AeroVironment, Inc , Pasadena, Calif.
**OPTIMIZATION OF THE DYNAMIC INDUCER WIND TURBINE SYSTEM**
P. B. S. LISSAMAN, A. D. ZALAY, and B. HIBBS *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 501-512 1981 refs
Avail: NTIS HC A23/MF A01

The dynamic inducer, essentially a horizontal axis wind turbine (HAWT) rotor with small vanes at the tips is a promising, advanced technology wind turbine concept. By adding small vanes to the tip of the conventional rotor, significant increases in power can be obtained with the dynamic inducer system. The development of the system is reviewed, including past theoretical and experimental programs Recent tow tests and wind tunnel tests established the predicted augmentation power. A new optimization program is outlined, based on advanced theory back by extensive wind tunnel testing, aimed at developing an advanced dynamic inducer system for a state-of-the art high performance, two-bladed rotor system. It is estimated that the dynamic inducer rotor is about 20% more cost-effective than a conventional system. Author

**N83-15941#** Sydney Univ. (Australia). Dept. of Mechanical Engineering.
**EXPERIMENTS WITH A TWIN ROTOR, SINGLE BLADED GYROMILL**
J. BLACKLER, A. J. BARRATT, H. NIBBE, and B. W. ROBERTS *In* Midwest Res. Inst. Fifth Bien. Wind Energy Conf. and Workshop (WW5) p 513-522 1981 refs Sponsored in part by the Energy Authority of New South Wales
Avail: NTIS HC A23/MF A01

The concept of a rotary-winged device known as a gyromill is designed. Such a machine is intended to ascend and descend helicopter fashion on its tethers, and yet be capable of generating electricity in a suitable wind. The philosophy of the current design is discussed along with a description of basic construction. The machine consists of twin, eight foot diameter rotors to give an all-up weight of around 70 lb. Preliminary validation of the motor and rotor system was achieved and further experiments are planned. Author

**N83-15954#** Sandia Labs., Albuquerque, N. Mex.
**VERTICAL-AXIS WIND-TURBINE PROGRAM**
R. H. BRAASCH 1981 28 p refs Presented at the 5th Bien. Wind Energy Conf. and Workshop, Washington, D. C., 5 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-003531; SAND-81-1804C; CONF-811043-12) Avail: NTIS HC A03/MF A01

The vertical axis wind turbine program is discussed. Progress in aerodynamics research, structural dynamics research, and machine development is reviewed. Laminar flow, boundary layer control, cambered blades, and costs are also discussed. DOE

**N83-16114#** Ceskoslovenska Akademie Ved, Prague Inst. of Plasma Physics.
**ELEVENTH CZECHOSLOVAK SEMINAR ON PLASMA PHYSICS AND TECHNOLOGY**
Oct. 1981 167 p refs Seminar held in Zvikov, Czechoslovakia, 7-9 Oct. 1981
(IPPCZ-244) Avail: NTIS HC A08/MF A01

Various aspects of plasma physics and Tokamak devices are discussed. Emphasis is placed upon plasma heating. Radio frequency heating, magnetohydrodynamic waves, toroidal plasmas, plasma-electromagnetic interaction, and plasma density are among the topics discussed. R.J.F.

**N83-16115#** Kurchatov (I. V.) Inst of Atomic Energy, Moscow (USSR).
**TOKAMAK RESEARCH IN THE SOVIET UNION**
V. S. STRELKOV *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 3-13 Oct. 1981 refs
Avail. NTIS HC A08/MF A01

Experimental research and engineering to provide the basis for fusion reactor design are discussed. Various methods of plasma heating are discussed. Magnetohydrodynamic waves, toroidal fields, radio frequency heating, microwave frequencies, cyclotron radiation, and adiabatic compression are discussed R.J.F.

**N83-16116#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**LOWER-HYBRID HEATING EXPERIMENT ON THE TM-1-MH TOKAMAK**
J. DATLOV, K. JAKUBKA, V. KOPECKY, S. KOERBEL, L. KRYSKA, P. MAGULA, J. STOECKEL, and F. ZACEK *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 37-40 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

During preliminary experiments on the plasma heating region in the TM-1-MH device high frequency (HF) power up to 100 kW at the frequency of 616 MHz was injected into the Tokamak by means of a loop fed by a coaxial line. The process of HF field-plasma interaction was found strongly nonlinear in the whole 3 to 100 kW power range. It takes place predominantly at the periphery of the plasma column. Electron density increase during the heating process was reduced by working at various temperatures of the liner up to 300 C. R.J.F.

**N83-16117#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**POWER SPECTRUM OPTIMIZATION OF THE THREE-WAVEGUIDE GRILL FOR THE T-7 TOKAMAK**
J. PREINHAELTER, Z. SEDLACEK, and S. KOERBEL *In its* 11th Czechoslovak Seminar on Plasma Phys and Technol. p 41-46 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Phased array of waveguides, named the grill, is usually used as a coupling structure in experiments with the lower hybrid resonance heating of plasma. In this case the grill consists of three elements. In the theoretical model it is assumed that the height of waveguides is infinite (in the y-direction) and the slab geometry is adopted with the x-axis along the toroidal magnetic field. The field in waveguides is assumed to be the sum of transverse magnetic modes (in numerical computations 10 modes were taken), from which only the first mode is propagating and the others are evancescent. It is also supposed that only the slow wave is present in the plasma and that the plasma density profile is linear. R.J.F

**N83-16118#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**SHORT WAVELENGTH LOWER HYBRID WAVES NONLINEARLY EXCITED DUE TO PONDEROMOTIVE DENSITY MODULATION**
R. KLIMA, I. M. PANKRATOV, P. PAVLO, and V. A. PETRZILKA *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 47-51 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

One of several nonlinear mechanisms that can play a role in the lower hybrid heating process is discussed. Nonlinear density modulation due to ponderomotive forces is investigated. In the model, the magnetostatic field B sub 0 is parallel to the x-axis, while the x-axis is parallel to the density (and temperature) gradient. Because of the strong decrease of density modulation with increasing temperature, the nonlinearity is assumed to be negligible inside the plasma at a certain x = x sub f. High frequency field is launched from a waveguide array, separated from the plasma by a thin vacuum region. R.J.F.

**N83-16119#** State Coll. of Mining and Metallurgy, Ostaua-Poruba (Czechoslovakia). Dept. of Physics.
**ELECTRON IMPACT IONIZATION OF HIGHLY CHARGED MOLYBDENUM IMPURITIES IN TOKAMAK PLASMAS**
V. STRZONDALA *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 52-53 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Estimations of cross sections of molybdenum ions are discussed. An approximate calculation of the electron impact cross sections of ions is expressed. R.J.F.

**N83-16120#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**ANDROMEDA: THE SYSTEM FOR THE ACQUISITION AND NUMERICAL DATA PROCESSING AND ITS APPLICATION FOR EXPERIMENTAL DEVICE TOKAMAK TM-1-MH**
L. KRYSKA and S. KOERBEL *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 54-55 Oct. 1981
Avail: NTIS HC A08/MF A01

The operation of the Tokamak TM-1-MH experimental device demands a system for the registration and numerical processing of analog transient signals from various diagnostic sensors. These signals of relatively short duration (up to 10 ms) have a repetition period of 4 to 5 min approximately. A system, ANDROMEDA, for the registration and digital processing of analog transient signals from various diagnostic sensors in a Tokamak device is discussed. The four basic working regimes of the system ANDROMEDA are as follows: the registration of signals in the electronic buffer memory; the reconstruction of registered informations (the repetition regime); the transfer of collected data into the computer and the numerical processing of these data; and the displaying, plotting and printing of processed data (oscilloscope, plotter, printer). The data acquisition subsystem can be operated independently as an autonomous 16-channel digital-memory oscilloscope. R.J.F.

**N83-16121#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**SOFT X-RAY DIAGNOSTICS ON TOKAMAK TM-1-MH**
P. MAGULA *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 56-59 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Two kinds of soft X-ray detectors (the gas proportional detector and liquid nitrogen cooled Si (Li) detector) are used at the TM-1-MH Tokamak for the measurement of electron temperature T sub e and for the determination of the influence of high frequency (HF) heating on the electron distribution function in the Tokamak plasma. The heating experiments were made in two ranges of frequencies: 1,25 GHz and 616 MHz. In the first experiment at 1,25 GHz a magnetron was used as a power generator and T sub e(O) was determined by means of the gas proportional counter with the Be window of 0.0001 m thickness. The soft X-ray spectrum was measured in the 1,5 keV to 5 keV energy range. From the comparison of the X-ray spectra with and without HF heating respectively, it can be seen the influence of the HF heating starting from 2,7 keV energy which appears in the form of a tail in the distribution function with the temperature T sub e = 710 eV. Supposing that the level and composition of impurities do not change during the application of HF impulse it can be appreciated that approximately 1% of electrons are heated, consuming totally 0,5 kW of HF power. The Tcherenkov damping of electrons is supposed to be the absorption mechanism for the HF wave. R.J.F.

**N83-16122#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**ENERGY BALANCE IN TM-1-MH TOKAMAK (OHMICAL HEATING)**
J. STOECKEL, S. KOERBEL, L. KRYSKA, V. KOPECKY, V. DADALEC, J. DATLOV, K. JAKUBKA, P. MAGULA, F. ZACEK, G. V. PEREVERZEV (Kurchatov Inst. of Atomic Energy) et al. *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 60-64 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Plasma in the TM-1-MH Tokamak was experimentally studied in the parameter range: tor. mg. field B = 1,3 T, plasma current I sub p = 14 kA, electron density N sub E 3.10 to the 19th power cubic meters. The two numerical codes are available for the comparison with experimental data. TOKATA-code solves simplified energy balance equations for electron and ion components. TOKSAS-code solves the detailed energy balance of the ion component. R J F.

**N83-16123#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**COMPUTER SIMULATIONS OF REFLEX E-BEAM SYSTEMS AND PLASMA STABILITY**
K. JUNGWIRTH and P. STAVINOHA *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 77-93 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

A 1 1/2 dimensional PIC simulation model OREBIA was devised for systems with a virtual or reflex cathode to investigate various reflexing electron beam phenomena, dynamics of ions accelerated within the anode-cathode gap, ion beam generation, ion acceleration, evolution of the h,v, diode impedance and its matching to the external circuit, and further related phenomena. Schematics of the coupled to an external electric circuit model OREBIA-REX as well as of its central module OREBIA are illustrated. This model based on analytical estimates and set up in close correlation to experimental work was described in detail in the report. Following to its up to date version, electrons emitted from the (moving) surface of the cathode plasma and accelerated within the anode-cathode gap are scattered elastically and lose simultaneously some part of their energy at the (moving) boundaries of the anode (either externally or gas produced) plasma according to a foil-scattering model. B.W.

**N83-16124#** Institute of Nuclear Research, Swierk (Poland).
**FUSION AT COUNTERSTREAMING ION BEAMS: IONS OPTIC FUSION (IOF)**
M. GRYZINSKI *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol p 94-100 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Different concepts of a controlled fusion energy release were developed during over one quarter century lasting investigations. Those were mostly based on the concept of magnetic confinement of thermalized plasma. In the last decade research on fusion energy production in inertially confined thermal plasma were strongly developed. A bnef review of research on the fusion energy production at highly ordered motion of ions in counterstreaming ion beams is given. Author

**N83-16125#** Technical Univ. of Zamek (Czechoslovakia). Electrotechnical Faculty.
**DEVELOPMENT OF CURRENT SHEAT ON OUTPUT OF COAXIAL GUN**
J. KRAVARIK, P. KUBES, and J HRUSKA *In* Ceskoslovenska Akademie Ved 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 101-102 Oct. 1981
Avail: NTIS HC A08/MF A01

The investigation of current sheat collapse has been directed to the maximum gain of plasma density, plasma temperature and neutron production. The evolution of collapse is dealt with in this paper Author

**N83-16126#** Purkyne (J. E.) Univ., Kotlarska (Czechoslovakia). Dept. of Physical Electronics.
**COATING OF LASER FUSION TARGETS BY PLASMA POLYMERIZED ORGANIC THIN FILMS**
J. JANOA *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 103-104 Oct. 1981
Avail: NTIS HC A08/MF A01

The laser fusion targets are the deuterium - tritium filled spherical glass shells of the order of 100 - 200 micrometers in diameter and coated with 5 to 30 micrometers of density - matching, low atomic number material. The coating material must be of uniform density having the surface imperfections less than 5 x 0.01 micrometers. The filled glass shells cannot be heated above 200 C since the permeation rate of the DT of the shell may increase rapidly. Among evaluated methods available for depositing thin layers of this type, the plasma polymerization was found to be the best approach. In the literature described experiments have shown that the plasma polymerized fluorocarbons produce coatings having the densities from 1.8 to 2.4 g/cu cm. Author

**N83-16127#** Academy of Sciences, Berlin (East Germany). Zentralinst. fuer Elektronenphysik
**NUMERICAL SIMULATION OF COLLECTIVE ION ACCELERATION**
W. HINTZE *In* Ceskoslovenska Akademie Ved 11th Czechoslovak Seminar on Plasma Phys and Technol. p 105-106 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

A one dimensional particle simulation code was developed in order to study collective ion acceleration during injection of an IREB into initially neutral gas. Two different cases were treated: homogenous gas filling of the drift space, and gas cloud near the injection plane. Injection into a sharply localized ion source at the anode has been studied earlier. Contrary to our code, the diode region was included in the calculation. Details of our code are described. Electrons are injected with constant energy but with finite current risetime into a grounded drift space of length L which is filled with a gas from x = o to x = D( approx. L). The gas is ionized by electron impact with a constant ionization frequency The code was run for various combinations of the parameters. The main objective of the study was to assess the capability of a strictly one dimensional model. B W

**N83-16128#** Technical Univ. of Prague (Czechoslovakia).
**ION VELOCITY MEASUREMENTS FOR LASER MASS ABLATION STUDIES**
L. PINA *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys and Technol. p 107-108 Oct. 1981
Avail: NTIS HC A08/MF A01

The measurements used 10 J, 1.7 ns (FWHM), 1.06 micrometers laser pulse to irradiate flat Al targets. A range of lenses with focal lengths from 75 mm to 2000 mm were used to focus 50 mm diameter beam on target, resulting in a range of optical spot diameters from 30 micrometers to 3.5 mm. Irradiance on target was varied by inserting calibrated glass Nd filters in the main beam. Ion velocities were recorded using six time-of-flight Faraday cup collectors arrayed in the horizontal plane from 10 deg to 80 deg to the target normal at distances approx 40 cm from the plasma. The focal spot size was measured by imaging the focal plane distribution onto infrared film Ion velocities were calculated from the arrival time of the peak ion current. Polar ion velocity plots were extrapolated to determine the ion velocity normal to the target surface. These normal velocities were then plotted against irradiance I for each spot size. Random shots onto plastic targets showed no significant difference in measured velocities B.W.

**N83-16129#** Academy of Sciences, Berlin (East Germany). Zentralinst. fuer Elektronenphysik.
**CRATER FORMATION BY HIGH CURRENT DISCHARGES IN VACUUM**
P. SIEMROTH and B. JUETTNER *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 109-111 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Metal vapor arcs between cold electrodes in an ambient vacuum (so-called vacuum arcs) are characterized by small hot spots that rapidly and stochastically move over the surface. These cathode spots are characterized by a very high current density, high temperature and plasma density. Typical erosion marks - the craters - are left behind by the spots. Craters are assumed to play an important role for the current transfer from the cathode to the discharge plasma. Futhermore, they reflect the effort of producing the plasma itself. Therefore, the crater formation describes the essential process of the discharge. Low current experiments were carried out. B.W.

**N83-16130#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**SOFT X-RAY AND VUV EMISSION FROM REB-HEATED PLASMA IN REBEX 1 AMD REBEX 1 MACHINES**
V. PIFFL and V. RAUS *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol p 112-113 Oct. 1981
Avail: NTIS HC A08/MF A01

The measurements of soft X-ray spectra in REB-heated plasma experiments by means of a conventional scintillation technique is difficult due to the intense bremsstrahlung originating from interaction of beam electrons with a plasma and chamber walls. In the experiments with the REBEX 1 machine, predominantly radiation from a decaying plasma long after the beam injections pulse (t 0,5 micro sec.) could be measured in this way, although very thin plastic scintillators were used. The absorption characteristics of X-ray emission from a plasma are measured and compared with calculated Maxwellian plasma emission for several temperatures. To detect ultrasoft X-ray and VUV emission two types of photoemission detectors were developed Author

**N83-16131#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.
**DYNAMICAL MODEL OF AN OVERHEATED MAGNETIZED PLASMA**
K JUNGWIRTH and J. ULLSCHMIED *In its* 11th Czechoslovak Seminar on Plasma Phys and Technol. p 114-115 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

In experiments on plasma heating by REB on the REBEX machine diamagnetic measurements represent a basic method for evaluation of the plasma energy content and of the efficiency of REB-to-plasma energy transfer. Variety of forms of the observed diamagnetic signals implies a complicated nature of the energy transfer processes. To interpret correctly the diamagnetic data a simple but fairly general model describing the heated plasma dynamics was developed. Author

**N83-16132#** Academy of Sciences, Berlin (East Germany). Zentralinst. fuer Elektronenphysik.

**DYNAMICS OF IONIZATION AND TRANSPORT IN A MAGNETICALLY CONFINED PLASMA COLUMN**

H. PRINZLER and P. HEYMANN *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys and Technol p 118-125 Oct. 1981 refs

Avail. NTIS HC A08/MF A01

Transport processes in magnetized low temperature plasmas have been investigated during the past two decades up to the present. They are stimulated by the dominant role of anomalous transport in fusion devices, where the concept of wave induced perpendicular losses gives a promising model for physical explanation A disturbance of the plasma equilibrium distributed nearly homogeneous along the plasma column is used. The propagating density perturbation in radial direction is observed It was found that the perturbation propagates in an anomalous way with enhanced perpendicular transport, caused by a discrete spectrum of correlated drift-like modes. From the field equations for electrons and ions a rectangular slab model introduced by Aldrige and Keen has been derived which gives the dispersion of dissipative drift wave modes (Ellis, et al., 1980) B.W.

**N83-16133#** Institute of Physics and Technology of Radiation Devices, Bucharest (Rumania).

**A TIME RESOLVING METHOD FOR DETERMINING THE ENERGY SPECTRUM OF NEUTRONS EMITTED BY A PLASMA FOCUS DEVICE**

I. I. POPESCU and M. VLAD *In* Ceskoslovenska Akademie Ved 11th Czechoslovak Seminar on Plasma Phys. and Technol p 126-127 Oct. 1981 refs

Avail. NTIS HC A08/MF A01

A method to obtain the time evolution of the energy spectrum f(v,t)) of the neutrons emitted by a deuterium plasma produced in a plasma focus device is proposed The neutrons do not interact with the magnetic and electric fields and have negligible interaction with discharge vessel walls, the knowledge of their energy spectrum provides very accurate information on the neutron production mechanism present in the plasma focus. Neutron measurements determine the time averaged energy spectrum only. Such measurements are made by the time of flight method, and by recording the proton recoils in nuclear emulsions. The two methods, used on the same discharge give different results which indicates the existence of a time dependence in the neutron energy spectrum E.A.K.

**N83-16134#** Ceskoslovenska Akademie Ved, Prague Inst of Plasma Physics.

**APPARATUS FOR PLASMA ELECTRON TEMPERATURE AND DENSITY MEASUREMENTS BY THOMSON SCATTERING**

K. KOLACEK and V. BABICKY *In its* 11th Czechoslovak Seminar on Plasma Phys and Technol. p 128-129 Oct. 1981 refs

Avail: NTIS HC A08/MF A01

The Thomson scattering technique is based on fact, the monochromatic radiation passing a plasma is under certain circumstances dominantly scattered by freely moving electrons which causes its frequency to broaden by Doppler effect. A wavelength analysis of the scattered light yields an information on the electron motion and hence on the electron temperature, while the total power of the scattered light is proportional to the number of scattering centers and hence to the electron density Since the Thomson scattering cross section is small, an application of this technique was not possible only by giant pulse lasers with well collimated beams. Thomson scattering apparatus consists of the following parts: the laser, the interaction chamber and the detection system. The detection part enables the measurement of the scattered light spectrum in six spectral channels during one laser shot. By changing the dispersing element of the polychromator it is possible to change the dispersion range. E A.K

**N83-16135#** College of Mechanical and Electrical Engineering, Plzen (Czechoslovakia). Dept. of Physics

**DIAGNOSTICS OF NONEQUILIBRIUM HYDROGEN PLASMA**

J. FERDINAND *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 130-134 Oct. 1981 refs

Avail. NTIS HC A08/MF A01

Electron temperature measurements in low electron density plasma are discussed. Special plasma models are required in diagnostics of nonequilibrium plasma. Coronal and collisional radiative models are used. In low electron density regions the results obtained by both models are nearly equal. Both models allow to use for electron temperature measurements the method of ratio of intensities of two spectral lines Hydrogen glow discharge is verified. E.A.K.

**N83-16136#** Research Inst of Electrical Apparatus, Brno (Czechoslovakia)

**EQUIDENSITOMETRICAL EVALUATION OF A FILM RECORD OF AN SF6 SWITCHING ARC**

B SVEJDA and B. GROSS (Technical Univ., Brno, Czechoslovakia) *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol p 135-138 Oct. 1981 refs

Avail: NTIS HC A08/MF A01

An electric switching arc in a nozzle of an SF sub 6 circuit breaker was photographed by a high speed camera. The SF sub 6 circuit breaker used for the experiment was specially modified for physical measurements. These conditions allow an optical reach of the inside nozzle space and observation of the whole opening operation The instantaneous position of the electrodes is recorded exactly and a special adaptation of the high speed camera allows it to obtain an unambiguous correlation between electrical parameters of the observed switching arc and the respective photorecord of the arc. E A.K.

**N83-16137#** Ceskoslovenska Akademie Ved, Prague Inst. of Plasma Physics

**GLOBAL MODEL OF A HYBRID TOKAMAK REACTOR WITH AN AUXILIARY RF HEATING**

L KRLIN, P PAVLO, and Z TLUCHOR *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 143-152 Oct. 1981 refs

Avail· NTIS HC A08/MF A01

Estimates of basic parameters of a model of the hybrid Tokamak reactor are presented. For an auxiliary plasma heating, the absorption of lower hybrid waves is considered. The typical reactor parameters, the outgoing power, the power obtained by the deposition of the energy of alpha particles, the RF power absorbed in the plasma, the driven current coupled with the RF absorption and the production rate of the plutonium are estimated. E.A.K.

**N83-16138#** Ceskoslovenska Akademie Ved, Prague. Inst. of Plasma Physics.

**SIMULATION CODE OF RELATIVISTIC ELECTRON BEAM DIODES**

P. VRBA *In its* 11th Czechoslovak Seminar on Plasma Phys and Technol. p 153-156 Oct. 1981 refs

Avail: NTIS HC A08/MF A01

The opposing relativistic electron and ion flows in own or applied electric and magnetic fields inside the cylindrical diode were numerically analyzed. A finite size particle quasistatic computer model is developed via self consistent solution by differential equations. The behavior of relativistic electron and ion flux in self consistent electric and magnetic fields near the maximum of voltage pulse is determined. E.A.K.

**N83-16139#** College of Mechanical and Electrical Engineering, Plzen (Czechoslovakia). Dept. of Physics.
**HELIUM POPULATION MODEL**
J. SLAVIK *In* Ceskoslovenska Akademie Ved. 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 157-159 Oct. 1981
Avail: NTIS HC A08/MF A01

The radiation - scattering models of plasma were numerically analyzed. The construction of such a model for helium plasma which enables study of metastable state effects and their relatively many atomic data are discussed. E.A.K.

**N83-16140#** Ceskoslovenska Akademie Ved, Prague Inst. of Plasma Physics.
**NUMERICAL SIMULATION OF THE INTERACTION OF AN ELECTROMAGNETIC WAVE WITH AN INHOMOGENEOUS PLASMA**
J. LACINA and J. PREINHAELTER *In its* 11th Czechoslovak Seminar on Plasma Phys. and Technol. p 160-162 Oct. 1981 refs
Avail: NTIS HC A08/MF A01

Heating by high frequency waves was studied. A numerical code which enables the study of incidence of an electromagnetic wave on an inhomogeneous plasma was developed. The one dimensional model which are nonmagnetized plasma of the two fluid equations with a finite electron pressure and with the adiabatic condition for all processes is described. It is stipulated that in the initial moment the plasma builds up a slab with a symmetrical profile for both the density and the electron temperature. The equilibrium is attained by the presence of the symmetrical gravitational field. The incident wave on the plasma boundary fulfills the nonreflecting boundary conditions. The problem is solved by finite difference method. The results of the computation agree with the quasilinear theory of the ponderomotive forces. E.A.K.

**N83-16143#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PHYSICS (SELECTED ARTICLES)**
Z. SHIYAO, C. ZESHENG, X. XIAOLUNG, and H. QIANG 10 Sep. 1982 25 p refs Transl. into ENGLISH from Wuli (China), v. 10, no. 8, Aug. 1981 p 488-490
(AD-A119830; FTD-ID(RS)T-0802-82) Avail: NTIS HC A02/MF A01 CSCL 20H

Controlled nuclear fusion as a new energy source was investigated. It will be possible in the 1980's to obtain thermal nuclear ignition, and in the early 2000's nuclear fusion may be used to supplement the energy shortage. It is predicted that in the 2000's nuclear fusion will occupy an important position as a global source of energy E.A.K.

**N83-16211#** Electrotechnical Lab., Ibaraki (Japan).
**MASS BALANCE ON THE ARC MODE SEED ELECTRODES**
S. KORENAGA, H. IMAI, and T. MASUDA Sep. 1982 36 p refs Backup document for AIAA Synoptic scheduled for publication in the Journal of Energy, Jul.-Aug. or Sep.-Oct., 1983
Avail: NTIS HC A03/MF A01

The mass transfer of seed material caused by arcing of condensed seed materials in MHD channels was investigated. Experiments were conducted in an electric furnace at atmospheric pressure and 1,250 C; K2SO4 was used as the seed material. Mass balance models are proposed, and the equations which indicate the relationship between the evaporation rates and arc current are derived. These equations are compared with experimental results. At the cathode, the calculated values agree well with the measured values. At the anode, good agreement is not obtained, because only a part of potassium metal generated on the surface of electrode evaporates into the atmosphere.
M.G.

**N83-16214#** JAYCOR, Alexandria, Va.
**PERFORM EXPERIMENTS ON LINUS-O AND LTX IMPLODING LIQUID LINER FUSION SYSTEMS Final Report, 8 Sep. 1980 - 30 Sep. 1981**
E. P. SCANNELL 27 Aug. 1982 26 p refs
(Contract N000173-80-C-0463)
(AD-A120052; J206-82-012/6203) Avail: NTIS HC A03/MF A01 CSCL 20I

The Plasma Physics Division of the Naval Research Laboratory (NRL) has been conducting investigations of imploding liquid liner fusion systems for several years (Reference 1). This effort attained a significant milestone in 1978 with the construction of two machines: HELIUS and LINUS-O is a 60 MJ rotor system where a cylindrical liquid sodium - potassium (NaK) metal liner is radially compressed from a 30 cm to 1 cm diameter by gas pressure from multiple high explosive charges. These charges act on an annular piston in contact with the liquid NaK liner material. HELIUS is a half-scale vertical axis version of LINUS-O using high pressure helium to drive the annular piston. HELIUS is designed to be a test bed for new concepts and to permit testing of new modifications to LINUS-O. The principal virtue of HELIUS is its capability for ten to twenty shots per day as compared to two or three shots per day for LINUS-O. In addition, HELIUS is designed to provide higher drive pressures than were previously obtainable with water models for liner gydrodynamic studies and a magnetic flux compression capability up to approx. 100 kG. GRA

**N83-16217#** Princeton Univ., N. J. Plasma Physics Lab.
**HIGH-N COLLISIONLESS BALLOONING MODES IN AXISYMMETRIC TOROIDAL PLASMAS**
C. Z. CHENG 1981 39 p refs
(Contract DE-AC02-76CH-03073)
(DE82-002831; PPPL-1841) Avail: NTIS HC A03/MF A01

A collisionless kinetic ballooning mode equation, which includes the full ion finite Larmor radius (FLR), the magnetic drift, and the trapped electron effects is derived and investigated for a large aspect ratio circular flux surface equilibrium in the frequency regime, 0 mega/sub bi/, 0 mega/sub ti/ less than 0 mega less than 0 mega/sub be/, 0 mega/sub te/. The finite Larmor radius effects can reduce the growth rate, but do not stabilize the ballooning modes due to the destabilizing influence of the ion magnetic drift resonance. It is, in general, incorrect to simulate the FLR effects by employing the often used FLR modified model. The trapped electrons have a stabilizing effect due to the reduction of the destabilizing circulating electron parallel current perturbation. For typical Tokamak aspect ratio, the critical beta can be improved by 40%. DOE

**N83-16218#** Los Alamos Scientific Lab., N. Mex.
**ELMO BUMPY TORUS FUSION-REACTOR DESIGN STUDY**
R A. KRAKOWSKI and D. DEFREECE 1981 6 p refs Presented at the 9th Symp. on Eng. Probl. of Fusion Res., Chicago, Ill., 26 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-002388; LA-UR-81-3144; CONF-811040-50) Avail: NTIS HC A02/MF A01

A complete power plant design of a 1200-MWe ELMO Bumpy Torus Reactor (EBTR) is described. Those features that are unique to the EBT confinement concept are emphasized, with subsystems and balance-of-plant items that are generic to magnetic fusion being adopted from past, more extensive Tokamak reactor designs. This overview paper stresses the design philosophy and assumptions that led to an economic, 35-m major-radius design that at 1.4 MW/sq meter wall loading generates 4000 MWt with a 15% recirculating power fraction. DOE

**N83-16220#** Los Alamos Scientific Lab., N. Mex.
**HELIOS MOVABLE HARTMANN BALL**
H. E. TUCKER, R. D. DAY, R. O. HEDGES, J A. HANLON, and B. L. KORTEGAARD 1981 4 p Presented at the 7th Conf. on Appl. Mech., Kansas City, Mo., 7 Dec. 1981
(Contract W-7405-ENG-36)
(DE82-000756; LA-UR-81-2874; CONF-811209-1) Avail: NTIS HC A02/MF A01

The Helios movable Hartmann ball is described in its function to precisely align the laser and target area. It provides the laser fusion facility with additional target illumination flexibility so that many additional parameters can be investigated in the realm of target implosion physics. DOE

**N83-16222#** Princeton Univ., N. J. Plasma Physics Lab.
**EFFECT OF LOW-FREQUENCY DENSITY FLUCTUATIONS ON ION-CYCLOTRON WAVES**
M. ONO Oct. 1981 34 p refs
(Contract DE-AC02-76CH-03073)
(DE82-002829; PPPL-1836) Avail: NTIS HC A03/MF A01

Scattering of waves in the ion cyclotron range of frequencies by low-frequency fluctuations is analyzed in the weak turbulence approximation. Finite-ion-Larmor radius, multi-ion-species, ion-drift-motion, and electromagnetic terms are included in the wave kinetic equation. Conditions for significant scattering have been identified for the fast wave as well as for externally launched ion Bernstein waves. Implications for ICRF heating in Tokamak plasmas are discussed. DOE

**N83-16226#** Association Euratom-CEA, Fontenay-aux-Roses (France).
**STUDY OF THE IONIC DISTRIBUTION AND OF THE ENERGY DEPOSITION IN A PLASMA OF TOKAMAK HEATED BY INJECTION OF FAST NEUTRALS Ph.D. Thesis - Paris-Sud Univ.**
B. GAGEY Mar. 1981 162 p refs In FRENCH; ENGLISH summary
(EUR-CEA-FC-1094) Avail: NTIS (US Sales Only) HC A08/MF A01; DOE Depository Libraries

In the Tokamak TFR 600 fast neutrals injection is done almost perpendicular to the magnetic field so it is expected theoretically that perpendicular injection would be more susceptible to drive microinstabilities. Assuming the energy slowing-down is classical, a Monte-Carlo code was modified to calculate self-consistently the behavior of the fast ions in the real plasma and the real magnetic configuration. The code allows to obtain the energy deposition profiles and the fast ions distribution function at a given moment of the injection. Absolutely calibrated electrostatic analyzers measured the fast ions which are lost by charge exchange versus toroidal and poloidal angles in different experimental conditions. The measurements are in good agreement with the code. Plasma evolution during injection was studied by assuming the calculated energy deposition profiles. The Monte-Carlo code was coupled with a one dimensional plasma simulation code which treats the evolution of the densities, temperatures and ohmic current, without any additional heating. DOE

**N83-16227#** Los Alamos Scientific Lab., N. Mex.
**ION KINETIC EFFECTS ON THE TILT MODE IN FRCS**
J. L. SCHWARZMEIER, C. E. SEYLER (Cornell Univ., Ithaca, N.Y.), and D. C. BARNES (Texas Univ, Austin) 1981 5 p refs Presented at the 4th Symp. on the Phys. and Technol. of Compact Toroids, Livermore, Calif., 27-30 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-002329; LA-UR-81-3159; CONF-811087-5) Avail: NTIS HC A02/MF A01

Theory and simulations show that field reversed configurations (FRG's) should be unstable magnetohydrodynamically to the tilting mode, yet tilting seldom is seen in the experiments. Profile effects (within MHD) and ion finite larmor radius effects are proposed to explain the observed stability of FRC's. DOE

**N83-16228#** California Univ., Livermore. Lawrence Livermore Lab.
***THE MFTF-B PLASMA DIAGNOSTIC SYSTEM***
A. L. THROOP, D. A. GOERZ, and S. R. THOMAS 21 Oct. 1981 7 p refs Presented at 9th Symp. on Engr. Probl. of Fusion Res., Chicago, 26 Oct. 1981 Submitted for publication
(Contract W-7405-ENG-48)
(DE82-002594; UCRL-86124; CONF-811040-58) Avail: NTIS HC A02/MF A01

The plasma diagnostic system for MFTF-B is described. The system requirement changes which have occurred as a result of the funded rescoping of the original MFTF facility into MFTF-B are discussed. The diagnostic instruments which are planned are outlined and an overview of the diagnostic system is presented. DOE

**N83-16229#** Texas Univ., Austin Inst. for Fusion Studies.
**STABILIZATION OF AXISYMMETRIC MIRROR PLASMA BY ENERGETIC ION INJECTIONS**
F. L. HINTON and M N. ROSENBLUTH Oct. 1981 37 p refs
(Contract DE-FG05-80ET-53088)
(DE81-030341; DOE/ET-53088/42) Avail: NTIS HC A03/MF A01

Plasmas in axisymmetric mirror devices can be made stable to MHD interchange modes by injecting energetic ions which contribute significantly to the pressure and spend a sufficiently large fraction of a bounce time in regions of favorable curvature. Pitch angle scattering adversely affects the method by reducing this fraction. The ions must be sufficiently energetic that pitch-angle scattering is not detrimental for that part of a slowing-down time during which they contribute significantly to the pressure. We have solved the bounce-averaged Fokker-Planck equation, including drag and pitch-angle scattering, and calculated the energetic ion contribution to the stability integral. With specially tailored magnetic fields, the required injection energy and power draining are found to be reasonable. DOE

**N83-16230#** Oak Ridge National Lab., Tenn.
**AUTHORS GUIDE TO PUBLISHING IN THE FIELDS OF PLASMA PHYSICS AND CONTROLLED FUSION**
Oct. 1981 29 p Presented at the 23rd Ann. Meeting of the Div. of Plasma Phys. of the APS, New York, 12 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-002866; CONF-811028-7) Avail: NTIS HC A03/MF A01

The purview, audience, and special restrictions are listed for 27 journals in the international literature that publish articles on plasma physics and controlled fusion. A.R.H.

**N83-16231#** General Atomic Co , San Diego, Calif.
**PROSPECTS OF LOW-ACTIVATION FUSION-REACTOR DESIGN**
G. R. HOPKINS, E. T. CHENG, I. MAYA, C. P. C. WONG, and K. R. SCHULTZ Oct. 1981 7 p refs Presented at 9th Symp. on Engr. Probl. of Fusion Res., Chicago, 26-29 Oct. 1981 Submitted for publication
(Contract DE-AT03-76ET-51011)
(DE82-003198; GA-A-16552; CONF-811040-88) Avail: NTIS HC A02/MF A01

A design study was performed to investigate the implications of using low activation materials in a fusion power reactor. Using the STARFIRE reactor as a model, low activation design concepts were studied for the four major regions of a fusion reactor: first wall and limiter, blanket, shield, and magnet windings. The first wall and limiter are made of water-cooled aluminum. The blanket uses an unpressurized silicon carbide structure containing Li2O breeding material with high temperature, high pressure helium coolant contained in SiC thimble tubes. The shield is made of SiC and B4C with an aluminum structure. The superconducting magnets use an aluminum stabilizer and aluminum or carbon fiber epoxy composite for the structure and dewar. DOE

## 05 ENERGY CONVERSION

**N83-16232#** Oak Ridge National Lab , Tenn
**ENGINEERING FEATURES OF THE INTOR CONCEPTUAL DESIGN**
T E. SHANNON 1981 4 p refs Presented at the 9th Symp. on Eng. Probl. of Fusion Res., Chicago, 26 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-002808; CONF-811040-90) Avail: NTIS HC A02/MF A01

The INTOR engineering design has been strongly influenced by considerations for assembly and maintenance. A maintenance philosophy was established at the outset of the conceptual design to insure that the Tokamak configuration would be developed to accommodate maintenance requirements. The main features of the INTOR design are summarized in this paper with primary emphasis on the impact of maintenance considerations. DOE

**N83-16233#** Oak Ridge National Lab , Tenn.
**CAMAC BASED INTER-COMPUTER COMMUNICATIONS SYSTEM**
D E. GREENWOOD and R D BURRIS 1981 3 p refs Presented at the 9th Symp on Eng Probl. of Fusion Res., Chicago, 26 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-002879, CONF-811040-93) Avail NTIS HC A02/MF A01

To provide communications between dissimilar computers for the ELMO Bumpy Torus (EBT) experiment CAMAC hardware was used. The software supports file and individual message transfers. The system has proven to be both reliable and fast, with transmission rates of about 36,000 baud. DOE

**N83-16259#** Los Alamos Scientific Lab., N Mex.
**APPLICATION OF FUEL CELLS TO HIGHWAY AND NONHIGHWAY TRANSPORTATION**
J R. HUFF, J. B. MCCORMICH, D. K. LYNN, R E BOBBETT, G R DOOLEY, C R. DEROUIN, H S MURRAY, and S. SRINIVASAN 1981 11 p refs Presented at the IGT Fuel Cells Technol Status and Applications Conf., Chicago, 16-18 Nov 1981
(Contract W-7405-ENG-36)
(DE82-004365, LA-UR-81-3424; CONF-811148-1) Avail NTIS HC A02/MF A01

Fuel cells are a promising alternate power source for transportation applications Modeling studies have indicated the potential for providing highway vehicles with performance and range comparable to those provided by internal combustion engines. Fuel cells are efficient and therefore reduce energy consumption. They are nonpolluting in terms of both air and noise pollution - highly desirable features for urban applications In addition, they can operate on nonpetroleum fuels such as hydrogen or hydrogen in combined form, for example, methanol or ammonia, thereby reducing the nation's petroleum dependency. The feasibility of using fuel cells in nonhighway transportation, i.e., rail and marine was also investigated DOE

## 06

## ENERGY TRANSPORT, TRANSMISSION, AND DISTRIBUTION

Includes transport of fuels by pipelines, tubes, etc., microwave power transmission, and superconducting power transmission

**A83-11283**
**CURRENT TOPICS OF SPS REALIZATION FROM A EUROPEAN VIEWPOINT**
W. WESTPHAL (Telefunken AG, Wedel, West Germany) In Space: Mankind's fourth environment, International Astronautical Congress, 32nd, Rome, Italy, September 1981, Selected Papers Oxford, Pergamon Press, 1982, p. 307-318.

European development of a solar power satellite system (SPS) as an aid to successful transition between dwindling fossil fuels and new, renewable energy sources expected in the 20th century is recommended, together with necessary research, technology, and siting requirements to achieve workable systems. Fossil fuel supplies are expected to be unavailable before fusion and renewable energy sources are able to compensate for the shortfall in the European energy supply The construction of off-shore polders for rectennas is shown to provide the area which is not available on the European land mass. The $5 billion projected cost of one rectenna, combined with the reference SPS design, yields a COE of 1.4-1.8 cents/kWh delivered Necessary technology advancements in the areas of the beam, solar cells, mass production and modularity of SPS components, and thermal sensitivity are reviewed. M.S.K.

**A83-11515**
**THE EFFECT OF THE PARAMETERS OF METAL-FIBER CAPILLARY STRUCTURES ON THE MAXIMUM HEAT-TRANSFER CAPABILITY OF THERMAL PIPES [VLIIANIE PARAMETROV METALLOVOLOKNISTYKH KAPILLIARNYKH STRUKTUR NA MAKSIMAL'NUIU TEPLOPEREDAIUSHCHUIU SPOSOBNOST' TEPLOVYKH TRUB]**
M G. SEMENA and A. N GERSHUNI (Kievskii Politekhnicheskii Institut, Kiev, Ukrainian SSR) Inzhenerno-Fizicheskii Zhurnal, vol 43, Oct. 1982, p 604-609 In Russian.

Previous studies are used in analyzing the influence of structural and geometrical characteristics of metal-fiber structures on the heat-transfer capability For various orientations in a gravitational field, recommendations are made for determining the characteristics of capillary structure that will ensure a maximum heat-transfer ability for given design parameters dealing with the casing, operating temperature, and heat carrier. C R.

**A83-11525#**
**ABSORPTION REFRIGERATION MACHINES**
C KEIZER Delft, Technische Hogeschool, Doctor in de Technische Wetenschappen Dissertation, 1982 224 p. refs

Theoretical aspects and experimental results are presented for improving absorption refrigeration machines using water-NH3 as the working fluid and powered by solar or waste heat. Efforts were made to define optimized working conditions, with consideration given to both the internal and external efficiencies of the absorber. Vertical tubular bubble absorbers were chosen as the system offering the best efficiencies in terms of heat and mass transfer The refrigerant and the solution are introduced at the bottom of a 25 mm diam vertical tube, producing a two-phase gas-liquid flow A computer simulation was developed to account for the amount of water in the refrigerant, the efficiency of the heat exchange in the thermal compressor, and the internal and external efficiencies of the absorber, especially in marginal working conditions A test model was built to establish rules for the design of bubble absorbers. A complete system was run for two years, finding discrepancies between the model to the performance to lie only with the evaporator. Steady state operation was satisfactory, with performance exceeding that of a film absorber system by a factor of two or more. M.S K.

**A83-16089**
**FIELD IONIZATION OF DEEP LEVELS IN SEMICONDUCTORS WITH APPLICATIONS TO HG/1-X/CD/X/ TE P-N JUNCTIONS**
W. W ANDERSON and H. J. HOFFMAN (Lockheed Research Laboratories, Palo Alto, CA) Journal of Applied Physics, vol. 53, Dec 1982, p. 9130-9145. Research supported by the Lockheed Independent Research Funds. refs

**A83-16093*** National Bureau of Standards, Washington, D.C.
**USE OF THERMOCAPILLARY MIGRATION IN A CONTROLLABLE HEAT VALVE**
L. A. SCHMID (National Bureau of Standards, Thermophysics Div., Washington, DC) Journal of Applied Physics, vol. 53, Dec 1982, p. 9204-9207. NASA-supported research. refs

In accordance with the Marangoni effect, immiscible droplets in a host fluid in which a temperature gradient exists move in the direction of increasing temperature. It is proposed that this

thermocapillary migration could be used to construct a 'liquid wick' that would return the condensed vapor at the condenser end of a heat pipe back to the evaporator, thus completing the fluid circuit. The droplets would be formed by capillary pressure forcing the condensate through a perforated diaphragm whose temperature would control the droplet flux, and hence the heat flux between the two ends of the heat pipe, thus making it a controllable heat valve. (Author)

**A83-16647#**
**FULLY CONTROLLABLE HEAT PIPE CONTAINING A SHORT ELECTRO-OSMOTIC PUMPING SECTION**
A. A. M. DELIL (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 12 p Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart. refs
(AIAA PAPER 83-0317)

It is pointed out that an electro-osmotic heat pipe (EOHP) is basically a varible conductance heat pipe for which the control properties are realized by the incorporation of a short electro-osmotic pumping section. This section, the 'EO-plug,' controls the liquid flow in the heat pipe wick system and, therefore, the flow rate supplied to the heat pipe evaporator. The underlying theory and the equations governing EOHP performance follow in straightforward fashion from combining heat pipe theory and electro-osmotic considerations. Theoretical considerations result in the definition of two new figures of merit: the electro-osmotic figure of merit, which compares electro-osmotic transport with capillary transport, and the transport capability reduction factor, which represents the flow reducing resistance caused by the EO-plug. Together with the classical heat pipe numbers (liquid transport number, wick number, and wicking height), these figures of merit make it possible to compare EOHP working fluids, plug configurations, and EOHP performance. C.R.

**A83-16648#**
**PERFORMANCE CHARACTERISTICS OF THE DOUBLE-WALL ARTERY HIGH CAPACITY HEAT PIPE**
R. PONNAPPAN (Universal Energy Systems, Dayton, OH) and T. MAHEFKEY (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 9 p USAF-supported research. refs
(AIAA PAPER 83-0318)

The results of additional tests carried out on the double-wall artery heat pipes show that the condenser temperature drop is significantly reduced by increasing the vapor flow slot area (for a fixed condenser length) or by increasing the external surface area of the condenser (for a fixed vapor slot area geometry). The evaporator heat flux and transport capacity are shown to be significantly reduced by elimination of the fine groove structure on the inside of the outer tube. Theoretical predictions of maximum radial liquid pressure drop in the evaporator, adiabatic, and condenser sections are found to correlate well with observed experimental results. Estimates of evaporator superheats caused by the increased vapor pressure drop inherent in the inner tube vapor slot area restrictions suggest only small superheat differences when compared with the unrestricted open wicks for similar heat fluxes and temperatures. C.R.

**A83-16649*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
**RADIANT HEATING TESTS OF SEVERAL LIQUID METAL HEAT-PIPE SANDWICH PANELS**
C. J. CAMARDA (NASA, Langley Research Center, Loads and Aeroelasticity Div., Hampton, VA) and A. BASIULIS (Hughes Aircraft Co., Dynamics Div , Torrance, CA) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 21st, Reno, NV, Jan. 10-13, 1983, 8 p. refs
(AIAA PAPER 83-0319)

Integral heat-pipe sandwich panels, which synergistically combine the thermal efficiency of heat pipes and the structural efficiency of honeycomb sandwich construction, were conceived as a means of alleviating thermal stress problems in the Langley Scramjet Engine. Test panels which utilized two different wickable honeycomb cores, facesheets with screen mesh sintered to the internal surfaces, and a liquid metal working fluid (either sodium or potassium) were tested by radiant heating at various heat-load levels. The heat-pipe panels reduced maximum temperature differences by 31 percent with sodium working fluid and 45 percent with potassium working fluid. Results indicate that a heat-pipe sandwich panel is a potential, simple solution to the engine thermal stress problem. Other interesting applications of the concept include: cold plates for electronic component and circuit card cooling, radiators for large space platforms, low-distortion large area structures (e.g., space antennas) and laser mirrors. (Author)

**A83-18446**
**STARTUP CONDITIONS OF ALKALI-METAL VAPORIZATION FROM RECTANGULAR CHANNELS**
V. V. PROSVETOV and L. M. PROROK (Gosudarstvennyi Komitet po Ispol'zovaniiu Atomnoi Energii, Fiziko-Energeticheskii Institut, Obninsk, USSR) (Teplofizika Vysokikh Temperatur, vol. 20, May-June 1982, p. 515-521.) High Temperature, vol. 20, no. 3, Nov 1982, p. 441-447 Translation refs

Relations are obtained for determining the critical heat flux and temperature difference in a heat pipe under the startup conditions of liquid-metal vaporization from rectangular channels. The calculated and experimental values of the critical heat flux and the temperature difference in precritical and subcritical conditions of sodium vaporization from channels of width 0 68 mm are found to be in satisfactory agreement. Two limiting cases of heat-carrier vaporization from rectangular channels are found. The first is when the channel projections are dry, and the second is when the channel projections are completely wetted by heat carrier. C.R

**A83-19161**
**TRANSIENT SHUTDOWN OF AN AXIAL-GROOVE LIQUID TRAP HEAT PIPE THERMAL DIODE**
M. GROLL and W SUPPER Heat Transfer - Soviet Research, vol. 13, Nov.-Dec. 1981, p. 26-33 Translation

Experimental results for determination of the shutdown characteristics of a straight axial-groove aluminum liquid trap heat pipe diode are reported. The shutdown was effected by applying a constant heat flux to the condenser while leaving the evaporator and trap thermally free floating A theoretical model was developed for the various heat flows and the transient diode shutdown, and the maximum heat transport of an aluminum axial-groove diode was calculated with respect to an ammonia fill charge at 20 C. The condenser temperature was found to rise faster than predicted, while the model and data agreed better toward the end of shutdown. A need for a better estimate of the thermal losses to the environment is indicated. The model is regarded as useful for spacecraft thermal control systems. M.S.K.

**N83-10368#** Siemens A.G , Berlin (West Germany). Bereich Energietechnik.
**FUNDAMENTAL RESEARCH INTO HIGH VOLTAGES FOR FURTHER DEVELOPMENT OF ELECTRIC POWER DISTRIBUTION SYSTEMS Final Report, Dec. 1980**
E. GOCKENBACH, W. BUCH, M. CRUCIUS, A. DIESSNER, and H. LUEHRMANN Bonn Bundesministerium fuer Forschung und Technologie May 1982 111 p refs Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-064; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 23,50

In order to guarantee correct electric power distribution, the use of voltages between 765 and 1200 kV was investigated. This fundamental research was conducted in an 1800 kV outdoor test station. After describing the connection and protection devices of the three stage high voltage generating transformer, and the tested equipment which has to withstand humidity, rain, dirt accumulation,

snow, ice, and wind, the recording equipment and the transient measurements which result from breakdowns in the SF6 gas insulated equipment and from flashovers in long air gaps, are presented. To limit the effects of high voltage oscillation, damping resistance and short cicuiting equipment on the primary side of the transformers were used. In this way, the overvoltages were prevented from rising to dangerous levels. Author (ESA)

**N83-10370#** Kabelmetal Electro G.m.b.H., Hannover (West Germany).
**FLEXIBLE GAS INSULATED CABLE FOR HIGH POWER TRANSMISSION Final Report, Sep. 1981**
J. ARTBAUER and W. RENFTEL Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 105 p refs In GERMAN, ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-099; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 22

The dielectric losses which increase as the square of voltage and limit power transmission capacity of paper/oil impregnated isolated cables were studied. This limitation disappears by using gas insulation. Tube transmission lines isolated with SF6 gas were developed. Their conception was paired with a lot of inconveniences: short length, numerous connections, special curved sections and necessity of dilation joints A test cable was fabricated from Al wire conductors, epoxy resin spacer insulators, and an external sheath of 3 mm thick Al-Mn alloy strip. A special high tension testing device was also constructed. The development of such a cable for 220 kV and of its components involved electric field computations, electrical, mechanical, and thermal measurements, elaboration of test and calculation methods, manufacture and testing of cable samples. Tests show that the transmission capacity of the cable in air surpasses 1000 MVA. Due to the limits set by the sheath diameter and the gas pressure, the 380 kV level cannot be attained with the design.
Author (ESA)

**N83-10397#** Vereinigte Elektrizitaetswerke Westfalen A.G., Dortmund (West Germany).
**DETERMINATION OF FRICTION COEFFICIENTS ON SEVERAL DISTANT HEAT PIPE SECTIONS WITH DIFFERENT SLIDING PARTNERS Final Report, Dec. 1980**
R. GIRNUS and H. GERKEN Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 53 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-095; ISSN-0340-7608) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 11

The sticking friction coefficients of supports with different sliding parameters were determined close to operating conditions. Test results on lines in operation with unexpected high sticking friction figures are cited. The sliding partners steel/steel, galvanized steel/steel, and Teflon/steel were studied. The sticking friction values were determined from normal forces, pull force, and displacement measure amplitudes. The results of these tests with steel point to greater values than generally known and refer to values for Teflon/steel bearings Author (ESA)

**N83-10428#** Ruhrkohle A.G., Essen (West Germany).
**DEVELOPMENT, CONSTRUCTION, AND EXPERIMENTAL OPERATION OF AN IMPROVED CHAINLESS HAULAGE SYSTEM FOR DRUM-SHEARER LOADERS Final Report, Dec. 1980**
K. BRINKEN and K. H. KLIMEK Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 23 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-82-102; ISSN-0340-7608; RAG-317) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 4,50

A model of a chainless hauling system was studied. Many defects were found when operating under severe working conditions. Further development tried to overcome these weaknesses so that a modified system could improve production and viability. The new Rackatrack II system underwent successfully basic investigations. Subsequent underground testing took place. Run-out of the shearer-loader as a result of the cutting force action, wear and deformation of the pin-rack guides, and cleaning problems on the machine guides and the pin racks occured during operation. Since the problems which arose revealed basic problems of the system and its design principles, it is not deemed useful to pursue this project. Author (ESA)

**N83-10498#** Houston Univ., Tex.
**WATER DEMAND FOR GENERATING ELECTRICITY: A MATHEMATICAL PROGRAMMING APPROACH WITH APPLICATION IN POLAND**
J. C. STONE, F. D. SINGLETON, JR., A. SALEWICZ (Inst. of Meteorol. and Water Management), M. GADKOWSKI (Inst. of Meteorol. and Water Management), and W. SIKORSKI (International Inst. for Applied Systems Analysis) Laxemburg, Austria International Inst. for Applied Systems Analysis Apr. 1982 66 p refs Sponsored by Siftung Volkswagenwerk
(IIASA-RR-82-16; ISBN-3-7045-0036-4) Avail: Issuing Activity

A resource use model for a coal fired power plant on a river was developed. The model optimizes plant design and operation in a number of user defined seasons. Alternative modes of coal transport, railroad, and slurry pipeline are modeled. Air and water quality dominate optimization. Coefficients are specified using matrix generators. Demand curves for water withdrawals and heat discharges, a water loss-withdrawal tradeoff, and the effects on the marginal and average costs of electricity due to reducing water withdrawals are calculated. Author (ESA)

**N83-12344#** Los Alamos Scientific Lab., N. Mex.
**SUPERCONDUCTING-TRANSMISSION-LINE PROJECT AT THE LOS ALAMOS NATIONAL LABORATORY Final Progress Report, 1 Oct. 1980 - 30 Sep. 1981**
W. E. KELLER, comp., J. A. BARCLAY, K. C. LIM, M. P. MALEY, L. R. NEWKIRK, W. F. STEWART, J. D. THOMPSON, and F A. VALENCIA Jul. 1982 38 p refs
(Contract W-7405-ENG-36)
(DE82-021835; LA-9342-PR) Avail: NTIS HC A03/MF A01

Results are presented of experiments aimed at developing advanced, high-capacity, power transmission conductors using superconducting materials derived from Nb3Ge. Successful efforts for producing a model superconducting (Nb3Sn) joint for use in superconducting lines are described. Realistic theoretical calculations have been completed on the cooldown of a model ac transmission line designed by the Brookhaven National Laboratory program. DOE

**N83-12387#** Argonne National Lab., Ill. Components Technology Div.
**DEVELOPMENT OF ENHANCED HEAT TRANSFER/TRANSPORT/STORAGE SLURRIES FOR THERMAL-SYSTEM IMPROVEMENT**
K. E. KASZA and M. M. CHEN (Illinois Univ., Urbana-Champaign) Jun. 1982 40 p refs
(Contract W-31-109-ENG-38)
(DE82-021236, ANL-82-50) Avail: NTIS HC A03/MF A01

Combined utilization of the phenomenon of increased energy transport due to the phase transition of an immiscible change of phase additive to a carrier fluid (slurry) with the recently recognized phenomenon of enhanced heat transfer at a surface due to particle/fluid boundary-layer interaction can be used to enhance overall thermal system performance. The enhancement will also be realized in conjunction with thermal systems employing direct contact heat exchangers. A benefit accruable from using phase change slurries in thermal systems rather than single phase sensible heat fluids are increased fluid/solid surface heat transfer coefficients resulting from several mechanisms This reduces the temperature difference required for a given amount of heat transfer and allows reductions in heat transfer surface areas. DOE

**N83-12525*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HEAT PIPE THERMAL SWITCH Patent Application**
D. A. WOLF, Inventor (to NASA) (Dynatherm Corp.) 15 Oct. 1982 12 p Sponsored by NASA
(NASA-CASE-GSC-12812-1; US-PATENT-APPL-SN-434674)
Avail: NTIS HC A02/MF A01 CSCL 10A

A thermal switch for controlling the dissipation of heat between a body acting as a heat source, and a heat sink is presented. The thermal switch is comprised of a flexible bellows defining an expansible vapor chamber for a working fluid located between an evaporation and condensation chamber. Inside the bellows is located a coiled retaining spring and four axial metal mesh wicks, two of which have their central portions located inside of the spring while the other two have their central portions located between the spring and the side wall of the bellows. The wicks are terminated and are attached to the inner surfaces of the outer end walls of evaporation and condensation chambers respectively located adjacent the heat source and heat sink. NASA

**N83-13248#** Societe Anonyme Belge de Constructions Aeronautiques, Brussels (Belgium).
**AGING OF SMALL CRYOGENIC HEAT PIPES Final Report**
Paris ESA 31 Mar. 1982 85 p refs
(SABCA-JPM/LN/H05/N28; ESA-CR(P)-1631) Avail: NTIS HC A05/MF A01

Stainless steel heat pipes with a diameter of 3mm and 6mm, charged with nitrogen, methane and ethane were placed in a chamber cooled with liquid nitrogen and operated during one year at a temperature within the working range of each heat carrier. Temperature distributions were monitored continuously and power performance was checked quarterly. A full performance test carried out after one year aging does not reveal significant degradations. Author (ESA)

**N83-13310#** Battelle Columbus Labs., Ohio.
**SYMPOSIUM ON PULSE-COMBUSTION APPLICATIONS. VOLUME 1: PROCEEDINGS**
Mar. 1982 323 p refs Symp. held in Atlanta, 2-3 Mar. 1982 Sponsored by Brookhaven National Lab. and Gas Research Inst. 2 Vol.
(PB82-240060; BCL-N-4007-1; GRI-82/0009.2-VOL-1) Avail: NTIS HC A14/MF A01 CSCL 13A

Pulse-combustion systems designed to take advantage of the phenomena of combustion-driven pulsations are discussed. Both recent R&D findings and field experience with commercialized equipment are covered. Applications include space heating, water heating, and industrial processes. Pulse-combustion systems are of special current interest because of their potential in firing efficient heating equipment having compact heat exchangers, including those operating in the condensing mode. GRA

**N83-13311#** Battelle Columbus Labs., Ohio.
**SYMPOSIUM ON CONDENSING HEAT EXCHANGERS. VOLUME 2: PROCEEDINGS**
Mar. 1982 386 p refs Symp. held in Atlanta, 3-4 Mar. 1982 Sponsored in by Brookhaven National Lab. and Gas Research Inst. 2 Vol.
(PB82-240078; BCL-N-4007-2; GRI-82/0009.3-VOL-2) Avail: NTIS HC A17/MF A01 CSCL 13A

Heat exchangers designed to recover a portion of the latent heat of the water vapor formed in the combustion process are discussed. They are applicable to equipment fired by either conventional power burners or pulse-combustion systems. Heat exchanger concepts and performance, corrosion resistant materials, condensate disposal, venting of flue gases and codes and standards are considered. Applications include use of condensing heat exchangers in conjunction with furnaces for space heating, and also with boilers for generation of steam or hot water for use in space heating or industrial processing. GRA

**N83-15892#** Thermacore, Inc., Lancaster, Pa.
**THE NEED FOR IMPROVED HEAT PIPE FLUIDS Final Report**
D. M. ERNST and G. Y. EASTMAN *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 15 p 1982 refs
Avail: NTIS HC A99/MF A01

Low mass high performance radiators and thermal management systems for advanced space systems are discussed. The key to these new improved thermal systems are high performance heat pipes. One aspect in achieving low mass/high performance heat pipes requires working fluids compatible with low mass materials of construction, such as aluminum, magnesium, beryllium and titanium. The application of heat pipe systems in manned spacecraft also requires the use of low or nontoxic working fluids. The development of new or improved heat pipe fluid/vessel combinations for advanced space systems should be carried out. Two approaches worthy of investigation are: the synthesis of new high performance fluids compatible with appropriate envelope materials and the development of integral impervious coatings and/or passivation to prevent the reaction of currently acceptable working fluids with the envelope. R.J.F.

**N83-15894#** Little (Arthur D.), Inc., Cambridge, Mass.
**TWO-PHASE HEAT TRANSPORT FOR THERMAL CONTROL Final Report**
A. A. FOWLE *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 2 18 p 1982 refs
Avail: NTIS HC A99/MF A01

The concept of the pumped, two phase flow heat transport system is discussed. The system consists of a closed fluid loop maintained in circulation by a pump. The fluid is preconditioned in a supply reservoir to be near saturation at a temperature level best suited to provide the heat source or sink necessary to the temperature control of the subsystems on the loop. A liquid vapor, two phase, saturated mixture of the working liquid is made to flow through heat stations (instrument modules in the case shown) arranged in series along the flow loop. Heat exchange at the heat stations involves change of phase, either condensation or evaporation, depending on whether cooling or heat addition is required. The net heat added by all instrument modules is rejected by a space radiator. The radiator functions as a condenser and is sized to handle the largest net heat addition to the fluid loop occurring during operation of the system. A temperature controlled fluid bypass and mixing valve (or other means) establishes the set point temperature of the fluid in the reservoir slightly below the saturation temperature corresponding to its pressure. The pump inlet is, therefore, supplied with slightly subcooled liquid from the reservoir to minimize the power required to circulate the fluid in the loop and to avoid cavitation induced difficulties. R.J.F.

# 07

# ENERGY STORAGE

Includes flywheels, heat storage, underground air storage, compressed air, storage batteries, and electric hybrid vehicles.

**A83-10651#**
**PERFORMANCE INVESTIGATION OF A LONG, SLENDER HEAT PIPE FOR THERMAL ENERGY STORAGE APPLICATIONS**
A. ABHAT (Stuttgart, Universitaet, Stuttgart, West Germany) Journal of Energy, vol. 6, Nov.-Dec. 1982, p. 361-367. refs

(Previously cited in issue 17, p. 3217, Accession no. A80-41473)

**A83-11509**
**METALLURGY OF RECHARGEABLE HYDRIDES**
P S RUDMAN and G D. SANDROCK (Inco Research and Development Center, Inc., Suffern, NY) In: Annual review of materials science. Volume 12. Palo Alto, CA, Annual Reviews, Inc , 1982, p 271-294. refs

Thermodynamic principles of metal-hydrogen (M-H) systems are reviewed, and the theory and practice of M-H alloys are detailed Pseudobinary systems, phase transformations, and metastability are briefly discussed The LaNi5-H system is used to examine plateau slope and hysteresis in M-H alloy formation, and the rules of simple averaging and reversed stability are assessed with respect to their usefulness in predicting the behavior of such systems The crystal structure of metal hydrides is addressed, including AB, AB2, and AB5 structure Finally, the use of ternary substitutional alloying in controlling the thermodynamic properties of M-H systems is discussed, illustrating the substitution of copper for nickel in LaN5 and the dependence of the equilibrium pressure on the unit cell volume of various CaCu5 type compounds. C D.

**A83-11813*** Jet Propulsion Lab., California Inst. of Tech., Pasadena
**POLYMERIC METALLIC ELECTRODES FOR RECHARGEABLE BATTERY APPLICATIONS**
R SOMOANO (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Applied Physics Communications, vol. 1, no. 2, 1981-1982, p. 179-191. refs
(Contract NAS7-100)

A review is presented on the status of plastic metal electrodes, emphasizing the use of polyacetylene as a prototype polymeric material. The electrochemical characteristics of polyacetylene are examined; and the potential use of this material, as well as other types of plastic metal electrodes, in batteries is evaluated Several problem areas which must be solved before polyacetylene can be widely used in battery applications are discussed, including the problem of electrolyte stability, the problem that the depth of discharge and the energy density is limited by the metal-semiconductor transition, and also the poor electrochemical performance of impure material. N.B.

**A83-12054**
**SOURCES OF PRESSURE IN LITHIUM THIONYL CHLORIDE BATTERIES**
R C. MCDONALD (GTE Sylvania, Waltham, MA) Electrochemical Society, Journal, vol. 129, Nov. 1982, p. 2453-2457. refs
(Contract F04704-78-C-0001)

The generation of pressure in Li/SOCl2 batteries has been investigated Hydrogen, sulfur dioxide, and nitrogen are the principal gases evolved. Reaction of lithium metal with protic species in the liquid electrolyte produces hydrogen gas on open circuit and more rapidly on discharge. Sulfur dioxide is a product of electrochemical discharge Nitrogen, trapped in lithium metal as dissolved gas or as lithium nitride is released during discharge In addition, smaller amounts of gas, trapped in cathode pores and adsorbed on the surface of carbon, are evolved when discharge products are deposited in the cathode. Hydrogen pressure is very sensitive to the care used in drying the electrolyte and cathodes. Alternate cycles of evacuation and backfill with SO2 eliminate much of the moisture and trapped gas from the cell prior to filling with electrolyte. (Author)

**A83-12055**
**TRANSPORT PROPERTIES OF NAFION MEMBRANES FOR USE IN THREE-ELECTRODE PHOTOELECTROCHEMICAL STORAGE CELLS**
P. BRATIN and M. TOMKIEWICZ (Brooklyn College, Brooklyn, NY) Electrochemical Society, Journal, vol. 129, Nov. 1982, p 2469-2473 refs
(Contract XS-9-8312-1)

The diffusion coefficients and fluxes of sulfide and polysulfide species through Nafion membranes have been determined in order to correlate the physical properties of these membranes with their actual performance in three-electrode photoelectrochemical storage cells. Diffusion coefficients for sulfide range from about 3 x 10 to the -9th to 1 x 10 to the -7th sq cm/sec, depending on the equivalent weight and thickness of the membrane, and the pH of the solution. Diffusion coefficients for polysulfide are considerably lower, and some reasons are discussed. A Nafion 315 membrane was chosen for the first test in the storage system and the results of the test are presented. (Author)

**A83-14045**
**INTERNATIONAL CONFERENCE ON ENERGY STORAGE, BRIGHTON, SUSSEX, ENGLAND, APRIL 29-MAY 1, 1981, PROCEEDINGS**
Conference sponsored by BHRA Fluid Engineering. Cranfield, Beds , England, BHRA Fluid Engineering, 1981. 389 p.

Current developmental, experimental, and production prototype energy storage systems are surveyed, with an emphasis on European programs and products. Attention is given to chemical, thermochemical/heat pump combinations, and reversible reaction heat storage methods. Applications of zeolite, hydrogenated cyclohexane, and fluidized media are examined, as are thermal storage options for industry and utilities. Phase change materials in bulk, encapsulated, and sodium acetate forms are reviewed, particularly for solar energy thermal storage. The compatibility of construction materials with latent heat storage is discussed. Battery systems for transport vehicles, load leveling, and storage of solar and wind-derived electricity are described Aquifer storage is explored, together with underground pumped hydro and compressed air energy storage, a two-basin tidal power scheme, and kinetic energy rings such as flywheels. M.S K.

**A83-18562**
**THE EFFECT OF CRYSTAL SIZE ON THE THERMAL ENERGY STORAGE CAPACITY OF THICKENED GLAUBER'S SALT**
S B. MARKS (Delaware, University, Newark, DE) Solar Energy, vol. 30, no. 1, 1983, p. 45-49. Research supported by the Pennsylvania Power and Light Co. refs

**N83-10373#** National Academy of Sciences - National Research Council, Washington, D C. High Energy Density Capacitors and Dielectric Materials Committee.
**PROCEEDINGS OF A SYMPOSIUM ON HIGH ENERGY DENSITY CAPACITORS AND DIELECTRIC MATERIALS**
C. W. REED, ed. 1981 204 p refs Symp. held at Boston, 28 Oct. 1980 Prepared for Sandia National Labs.
(PB82-197344) Avail· NTIS HC A10/MF A01 CSCL 09A

Several diverse applications, space satellites, weapons, laser fusion, and specialized power supplies, demand capacitors with higher energy densities (in joules per gram) than are ordinarily available in commercial capacitors for industrial and utility applications. Such high energy density capacitors experience a wide variety of duty cycles (from single pulses to continuous operation) and require special features such as compactness, lightness, long shelf life, or very high reliability The state of the art in high energy density capacitor technology is summarized, and areas of that technology in particular need of improvement are identified. GRA

**N83-10558*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EXPECTED CYCLE LIFE VERSUS DEPTH OF DISCHARGE RELATIONSHIPS OF WELL BEHAVED SINGLE CELLS AND CELL STRINGS**
L. H. THALLER 1982 17 p refs Presented at the 162d Meeting of the Electrochem. Soc , Detroit, 17-22 Oct. 1982
(NASA-TM-82957; E-1372; NAS 1.15.82957) Avail: NTIS HC A02/MF A01 CSCL 10C

The factors that might influence the cycle life vs. depth of discharge relationship are examined. This is done first at the single cell level using a progressively more complex cell life model. This is then extended to multicell battery strings where the stochastic aspects associated with groupings of cells are introduced. These relationships are important when considering the weight, cost, and life of battery packs. The results of this theoretical study are

compared with a recent review of actual cell cycling data. The factors examined are the rate of capacity loss, the amount of excess capacity built into the cells, and the penalty in capacity loss resulting from the use of deep depths of discharge. This study suggests that the relationship between cycle life and depth of discharge is not one that can be varied of significantly improved by cell research The relationship appears to be determined by certain more or less fixed cell parameters. Among multicell strings, the standard deviation, as expected, plays an important role in determining overall battery life. Author

**N83-10614#** Friedrichsfeld G.m.b.H., Mannheim (West Germany). Steinzeug Und Kunststoffwerke.

**PRODUCTION TECHNOLOGY OF AN ELECTROLYTE FOR NA/S BATTERIES Final Progress Report, Jun. 1980**

G. HEIMKE, H. MAYER, and A. RECKZIEGEL Bonn Bundesministerium fuer Forschung und Technologie May 1982 82 p refs Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-82-065; ISSN-0340-7608) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 17

The trend to develop a cheap electrochemical electric battery and the development of the Na/S system are discussed. The main element in this type of battery is the beta Al2O3 solid electrolyte. Characteristics for this material of first importance are: specific surface, density of green and of sintered material, absence of cracks, gas permeability, resistance to flexion, purity, electrical conductivity, crystal structure and dimensions. Influence of production method on all these characteristics were investigated, e.g., method of compacting powder, tunnel kiln sintering versus static chamber furnace sintering, sintering inside a container or not, and type of kiln material when sintering in a container. In the stationary chamber furnace, beta alumina ceramics were produced with a density of 3.2 g/cm3, a mechanical strength higher than 160 MPa, and an electrical conductivity of about 0.125 Ohm-1cm-1 at 300 C. The best kiln material proved to be MgO and MgAl2O3.MgO ceramics. Author (ESA)

**N83-10619#** Gesamthochschule, Kassel (West Germany). Arbeitsgruppe Technische Physik.

**ELECTRON CONDUCTIVITY OF THE ACTIVE MASSES OF LEAD ACID BATTERIES DURING DISCHARGE AND PERMANENT SERVICE Final Report, Oct. 1980**

H. METZENDORF Bonn Bundesministerium fuer Forschung und Technologie Jun. 1982 102 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-82-078; ISSN-0340-7608) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 21,50

Electrical and structural properties of positive and negative grid plate electrodes in lead acid batteries were investigated during a single discharge and during permanent service. Theories of two phase resistor networks show an insulating behavior if there is more than a certain amount of a bad conducting phase. Results show that it is possible to describe the utilization of the electrodes during a single discharge at low current densities with these theories. The discharge is stopped by the breakdown of the electron conductivity of the active masses. A model is developed from which it is possible to calculate current distribution during discharge at low current densities. From this, conclusions are drawn as to the discharge behavior at high current densities. Author (ESA)

**N83-10627#** Institut fuer Kerntechnik und Energiewandlung e.V., Stuttgart (West Germany). Abteilung Energiewandlung und Waermetechnik.

**INVESTIGATION OF HEAT STORAGE FOR TEMPERATURE RANGE FROM 200 TO 500 C Final Report, Jun. 1981**

D. STEINER, D. HEINE, and A. NONNENMACHER Bonn Bundesministerium fuer Forschung und Technologie Jul. 1982 351 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-T-82-105; ISSN-0340-7608) Avail: NTIS HC A15/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 51,60

Possible heat storage methods for a temperature range from 200 to 500 C are reviewed to obtain higher specific heat content and to work at lower pressures. Three possible storage methods: sensible heat, latent heat or reversible chemical reactions, are reviewed. The thermodynamic quality and the efficiency of the storage system are defined. The material resistance, the cost, the thermodynamic quality, and the maintenance problems of the heat storage systems are discussed. Physical characteristic figures of possible heat storage materials are given. The various storage techniques are assesed with respect to thermal power plant applications. A thermal and cost analysis was carried out for oil/solid, molten salt/solid, or latent heat storage systems. Storage in oil or in the combination oil/solid material must be considered as an alternative to hot water storage. Author (ESA)

**N83-11017#** California Univ., Livermore Lawrence Livermore Lab.

**COMPOSITE-MATERIAL FLYWHEELS AND CONTAINMENT SYSTEMS**

S. V. KULKARNI *In its* Energy and Technol. Rev., Mar. 1982 p 18-29 Mar. 1982

Avail: NTIS HC A03/MF A01

The development of composite-material flywheels and containment systems is reviewed. Author

**N83-11578#** National Building Research Inst., Pretoria (South Africa).

**THE PREDICTION OF THE THERMAL PERFORMANCE OF BUILDING BY THE CR-METHOD**

J. D. WENTZEL, R. J. PAGE-SHIPP, and J. A. VENTER 1981 26 p

(CSIR-BRR-396; ISBN-0-7988-2047-0) Avail: NTIS HC A03/MF A01

A method for predicting the hottest and coldest likely indoor conditions in a house, given the materials of construction, general design details and layout is described. The procedure is based on an analysis of many measured values and thus requires no experimental verification. Although the calculation procedure, which is fully analyzed and illustrated by means of an example, is fairly complex, it requires no knowledge of advanced mathematics and all calculations can be done on a hand calculator The procedure is not meant to replace sophisticated building energy and thermal performance prediction computer programs but is aimed at users who do not have computer facilities but nevertheless wish to assess the likely thermal performance of different structures. The product of heat storage capacity (C) and weighted or equivalent resistance to heat flow (R) comprise one prediction method. The procedure assumes reasonable provision of cross-ventilation and also that windows are shaded to prevent direct sun penetration in summer. Author

**N83-11580*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**OAO-3 END OF MISSION POWER SUBSYSTEM EVALUATION**

M. TASEVOLI Aug. 1982 38 p refs Presented at the 17th IECEC, Los Angeles, 8-13 Aug. 1982

(NASA-TM-83959; NAS 1.15:83959) Avail: NTIS HC A03/MF A01 CSCL 10C

End of mission tests were performed on the OAO-3 power subsystem in three component areas: solar array, nickel-cadmium batteries and the On-Board Processor (OBP) power boost

operation. Solar array evaluation consisted of analyzing array performance characteristics and comparing them to earlier flight data. Measured solar array degradation of 14.1 to 17.7% after 8 1/3 years is in good agreement with theortical radiation damage losses. Battery discharge characteristics were compared to results of laboratory life cycle tests performed on similar cells. Comparison of cell voltage profils reveals close correlation and confirms the validity of real time life cycle simulation. The successful operation of the system in the OBP/power boost regulation mode demonstrates the excellent life, reliability and greater system utilization of power subsystems using maximum power trackers. Author

**N83-11582#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INDUCTIVE ENERGY STORES**
L. P. POBEREZHSKIY 9 Jul 1982 16 p refs Transl. into ENGLISH from Tr. Mosk. Energ. Inst. Elektroenerg. (USSR), no. 45, 1962 p 170-181
(AD-A118337; FTD-ID(RS)T-0877-82) Avail. NTIS HC A02/MF A01 CSCL 09A

Inductive energy stores research is reviewed. Discharge of the store is considered mathematically. Inductance coils are also discussed. N W.

**N83-11584#** Eltra Corp., Plymouth Meeting, Pa. Batteries Div.
**RESEARCH, DEVELOPMENT, AND DEMONSTRATION OF ADVANCED LEAD-ACID BATTERIES FOR UTILITY LOAD LEVELING Final Summary Report**
Mar. 1982 52 p refs
(Contract W-31-109-ENG-38)
(DE82-019796, ANL/OEPM-81-15) Avail: NTIS HC A04/MF A01

A cost and design study was conducted on the production of lead-acid batteries. The major conclusions with regard to a mature level of production, 1000 man-work hours (MWH) per year in 100 MWH installations, are the following: using vertically integrated, automated plants, and a 14 KAH cell design, it is projected that the 100 MWH battery can be manufactured for $76 per kilowatt hour (KWH). The large 10 and 14 kilowatt amphere hour (KAH) cells were found to be more economical than the small 3.4 KAH (6.5 KWH) cell. It is inferred that batteries prepared from large, cell sizes (10 and 14 KAH) will be inherently more reliable due to the reduced number of intercell connections and reduced number of cells requiring maintenance operations, compared to batteries made with small cells (3400 AH). The battery footprint energy density goal can be achieved with tiering of the 14 KAH cell and the specification of somewhat reduced aisle widths on the outside of the strings. Sensitivity studies were performed on the impact of lead price, design cycle life, materials cost reductions, and increase in active materials utilization on the cost of the 100 MWH battery. DOE

**N83-11599#** Brown, Boveri und Cie, A G., Heidelberg (West Germany). Zentralesforschungslabor/energiespeicherung.
**DEVELOPMENT OF THE SODIUM/SULFUR BATTERIES, PHASE 2 Final Report, Feb. 1981**
B. ADAMOWICZ, R. BAUER, W DOERRSCHEIDT, H. ESROM, W. FISCHER, W. HAAR, F. HARBACH, B. HARTMANN, D. HASENAUER, U. HUMRICH et al. Bonn Bundesministerum fuer Forschung und Technologie Aug. 1982 203 p refs In GERMAN; ENSLISH summary Sponsored by Bundesministerium fuer Forschung.und Technologie
(BMFT-FB-T-82-142; ISSN-0340-7608) Avail: NTIS HC A10/MF A01, Fachinformationszentrum, Karlsruhe, West Germany DM 36,50

In continuation of Na/S battery development major subjects were studied: optimization of cell performance; battery measurements, first practical battery test; and development of vacuum powder insulation. The energy density of standard cells was increased to 150 kWh/kg, at a discharging time of two hours, the maximum power density 120 W/kg The average duration of life was increased to 1350 charge/discharge cycles; 7 kWh batteries containing 112 individual cells revealed characteristics which were expected from single cell measurements Two of these batteries were successfully tested in a van. The heat losses of vacuum powder insulation amount to 70 W/m2; they are lower than the losses from a conventional heat insulation of 80 mm thickness. Author (ESA)

**N83-11610#** Swedish Council for Building Research, Stockholm.
**THERMOCHEMICAL HEAT STORAGE: STATE-OF-THE-ART REPORT**
G. OELERT, H. BEHRET, W. FRIEDEL, B. HENNEMANN, and D. HODGETT 1982 164 p refs
(PB82-188087; ISBN-91-540-3653-4) Avail: NTIS HC A08/MF A01 CSCL 10C

A thermochemical heat storage (TCHS) survey and assessment study is reported. Emphasis is given to energy use in buildings, but aspects of the industrial application of thermochemical heat storage are included. Systems of the type heat-in yields thermochemical reaction, yields heat-out are considered. Hydrogen technology, electrochemical, and photochemical methods are excluded. Various applications are considered, covering the most important sectors of energy consumption in Sweden. In this context, discontinuous sorption heat pumps, chemical heat storage, chemical heat pipes, and continuous sorption heat pumps are studied. Author (GRA)

**N83-12561#** Fenix and Scisson, Inc., Tulsa, Okla.
**PRELIMINARY DESIGN STUDY OF COMPRESSED-AIR ENERGY STORAGE IN A SALT DOME. VOLUME 4. CAES TURBOMACHINERY DESIGN Final Report**
P. ZAUGG, ed. Jun. 1982 273 p refs Prepared in cooperation with Middle South Services, Inc. and Brown Boveri Corp., North Brunswick and United Engineers and Constructors, Inc. 7 Vol.
(Contract DE-AC02-77ET-29015; EPRI PROJ. 1081-2)
(DE82-019781; EPRI-EM-2210-VOL-4; DOE/ET-5054/4) Avail: NTIS HC A12/MF A01

The question of whether it would be possible to build an air storage generating plant capable of operating economically and using leached out salt domes as air reservoirs was investigated. All the previous reports, most of which have been revised to a large extent, are included. DOE

**N83-12572#** Energy Research Corp., Danbury, Conn. Energy and Environment Div.
**DEVELOPMENT OF A HIGH-RATE INSOLUBLE ZINC ELECTRODE FOR ALKALINE BATTERIES**
A. CHARKEY Apr. 1982 33 p
(Contract DE-AC03-76SF-00098)
(DE82-020608; LBL-14674) Avail: NTIS HC A03/MF A01

The development of an insoluble zinc electrode for alkaline batteries is discussed. Active material was mixed dry with materials which would provide an insoluble matrix after initial reaction in the cell electrolyte. These electrodes are expected to exhibit improved performance in two ways. Firstly, there is an even distribution of permanent, highly conductive nucleation sites along the apparent electrode surface, providing for even Zn deposition and distribution during charging. Secondly, the increase in effective surface area decreases actual current densities, thereby, decreasing overvoltages. This should decrease dendrite formation and gas evolution in addition to allowing for the use of higher apparent current densities. Problems posed by the development of this type of electrode material are, for the most part, material selection problems. Materials must be chosen carefully, not just to fulfill their given function within the electrode system, but also to provide for minimal counterproductive interaction with each other. DOE

**N83-12573#** California Univ., Berkeley. Lawrence Berkeley Lab.
**TECHNOLOGY-BASE RESEARCH PROJECT FOR ELECTROCHEMICAL STORAGE REPORT FOR 1981**
F. MCLARNON, ed. Jun. 1982 95 p refs
(Contract DE-AC03-76SF-00098)
(DE82-020599; LBL-14305) Avail: NTIS HC A05/MF A01

The technology base research (TBR) project which provides the applied reseach base that supports all electrochemical energy storage applications: electric vehicles, electric load leveling, storage of solar electricity, and energy and resource conservation is described. The TBR identifies electrochemical technologies with the potential to satisfy stringent performance and economic requirements and transfer them to industry for further development and scale up. The TBR project consists of four major elements: electrochemical systems research, supporting research, electrochemical processes, and fuel cells for transportation. Activities in these four project elements during 1981 are summarized. Information is included on: iron-air batteries; aluminum-air batteries; lithium-metal sulfide cells; materials development for various batteries; and the characteristics of an NH3-air alkaline fuel cell in a vehicle. DOE

**N83-12582#** Westinghouse Electric Corp., Pittsburgh, Pa.
**RESEARCH, DEVELOPMENT AND DEMONSTRATION OF NICKEL-IRON BATTERIES FOR ELECTRIC-VEHICLE PROPULSION Annual Report, 1981**
Mar. 1982 128 p
(Contract W-31-109-ENG-38)
(DE82-021216; ANL/OEPM-81-14) Avail: NTIS HC A07/MF A01

Full-size, prototype cell, module and battery fabrication and evaluation, aimed at advancing the technical capabilities of the nickel-iron battery, while simultaneously reducing its potential cost in materials and process areas are discussed. Improved electroprecipitation process nickel electrodes of design thickness (2.5 mm) are now being prepared that display stable capacities for the C/3 drain rate with less than 10% capacity decline for greater than 1000 test cycles. Iron electrodes of the composite-type are delivering 24 Ah at the target thickness (1.0 mm). Iron electrodes also are displaying capacity stability for greater than 1000 test cycles in continuing 3-plate cell tests. Finished cells delivered 57 to 63 Wh/kg at C/3, and have demonstrated cyclic stability up to 1200 cycles at 80 percent depth of discharge profiles. Modules exceeded 580 test cycles and remain on test. Reduction in nickel electrode swelling (and concurrent stack starvation), to improve cycling, continues to be an area of major effort to reach the final battery cycle life objectives. DOE

**N83-12583#** Argonne National Lab., Ill.
**ANNUAL SYNOPSIS OF ARGONNE'S AQUEOUS BATTERY SUPPORT RESEARCH, FISCAL YEAR 1981**
Mar. 1982 38 p refs
(Contract W-7405-ENG-38)
(DE82-021143; ANL/OEPM-82-3) Avail: NTIS HC A03/MF A01

The major activities of the Battery Support Group research staff for fiscal year 1981 are described. The present activities are ultimately directed at improving the performance of lead-acid, nickel/zinc and nickel/iron batteries, especially those for electric vehicle or utility load-leveling applications. In addition to short descriptions of each of the projects, summaries of work accepted for publication, published or presented during the year are included. DOE

**N83-13415#** Science Research Council, Chilton (England).
**HEAT STORAGE AND HEAT PUMPS**
F. M. RUSSELL 1982 16 p Summary of workshop held at Coseners House, England, 3-4 Feb. 1982
(PB82-226481; RL-82-031) Avail: NTIS HC A02/MF A01 CSCL 13A

The subject of the Workshop was the case for, and technological aspects of combined heat stores and heat pumps. The objective was to identify areas of uncertainty or novelty to assist in formulating a program of perceived relevance to industry. It was concluded that combining heat stores with heat pumps increased the application areas gas heat pumps and gave increased flexibility in sizing and operation of such installations. Author (GRA)

**N83-13590#** Harry Diamond Labs., Adelphi, Md.
**THERMAL BATTERY SYSTEMS FOR ORDNANCE FUZING**
F. C. KRIEGER Jul. 1982 25 p refs
(Contract DA PROJ. 1L1-62603-AH-18; HDL PROJ. A18147)
(AD-A119155; HDL-TR-1989) Avail: NTIS HC A02/MF A01 CSCL 10C

Thermal battery technology for ordnance fuzing is reviewed. Most present thermal batteries use the Ca/LiCl-KCl eutectic/CaCrO4 system. This system is highly reliable when properly fabricated, but is subject to electrical short circuiting from CaLi2 formed during operation and is capacity and rate limited by anodic film formation. Proposed replacement electrochemical systems use lithium or its alloys as anodes to eliminate these difficulties, but the high chemical reactivity of lithium causes storage and handling problems. Anodes of calcium alloys might eliminate short circuiting and increase electrical output above that of the Ca/LiCl-KCl eutectic/CaCrO4 system without causing the handling and storage difficulties of the lithium systems The calcium alloy anode should be researched to determine its capabilities in practical batteries. Author (GRA)

**N83-13591#** Honeywell Power Sources Center, Horsham, Pa.
**LITHIUM-SULFUR DIOXIDE (LI/SO2) BATTERY SAFETY HAZARDS. THERMAL STUDIES Final Report, 24 Dec. 1980 - 5 Mar. 1982**
W. B. EBNER, K. Y. KIM, and H V VENKATASETTY Mar 1982 246 p
(Contract N60921-81-C-0085)
(AD-A119381) Avail: NTIS HC A11/MF A01 CSCL 10C

In this program, the Accelerating Rate Calorimeter (ARC) has been employed to study the thermal and pressure behavior of exothermic reactions occurring in Li/SO2 cells under the conditions of (1) forced overdischarge at ambient temperature, (2) resistive overdischarge at ambient temperature, (3) forced overdischarge at -35 C, and (4) discharge at -35 C. Detected reactions have been characterized in terms of self-heating rate, rate of pressure generation, magnitude of overall heat generation, magnitude of overall pressure rise, and kinetic parameters including activation energy and reaction order. Micro-calorimeter studies determined the heat of reaction for the lithium/acetonitrile reaction to be -54 + or - 1.0 kcal/mole-Li. Lithium/aluminum alloy was found to be unreactive with acetonitrile at ambient temperature. Preliminary investigations were also carried out using FTIR spectroscopy to study the products of electrolyte oxidation on nickel and stainless steel electrodes. Author (GRA)

**N83-13592#** Air Force Wright Aeronautical Labs, Wright-Patterson AFB, Ohio Aerospace Power Div.
**TESTING OF AN IMPROVED LITHIUM-SULFUR DIOXIDE BATTERY FOR AIRCREW LIFE SUPPORT EQUIPMENT Final Report, Jan. 1979 - Oct. 1981**
J. S. CLOYD May 1982 103 p refs
(Contract AF PROJ. 412A)
(AD-A119374; AFWAL-TR-81-2137) Avail: NTIS HC A06/MF A01 CSCL 10C

This report presents the results of in-house testing of lithium-sulfur dioxide cells. The report includes performance testing of an engineering prototype design of lithium-sulfur dioxide cells and the performance characterization, storage evaluations and abuse test behavior of the pilot production cell design. Several design modifications occurred during the development of this lithium-sulfur dioxide cell technology which significantly changed their performance. Testing of the pilot production cells included: (1) Performance evaluations at rates of 50MA, 100MA, 200MA, and 400 MA at temperatures from -65 F to +140 F; (2) Room temperature discharge tests at high rates of current; (3) Capacity retention capability as a function of storage time at temperatures

of 32 F, 70 F and 160 F; (4) Evaluation of intermittent storage capability at 205 F; and (5) Abuse testing. Abuse testing included short circuit, nail penetration, and forced overdischarge conditions. GRA

**N83-13607#** Acres American, Inc., Buffalo, N.Y
**PRELIMINARY DESIGN STUDY OF UNDERGROUND PUMPED HYDRO AND COMPRESSED-AIR ENERGY STORAGE IN HARD ROCK. VOLUME 8: DESIGN APPROACHES - UPH. APPENDIX B: SHAFTS Final Report**
Apr. 1981 92 p Sponsored by EPRI
(Contract DE-AC02-77ET-28013; EPRI PROJ. 1081-1)
(DE81-028202, EPRI-EM-1589-VOL-8-APP-B;
DOE/ET-5047-VOL-8-APP-B) Avail: NTIS HC A05/MF A01

An assessment of shaft requirements for an underground pumped hydroelectric (UPH) facility is documented. Shaft requirements for both the construction and the permanent operation phases of the facility are outlined. Possible shaft arrangements are developed and the design of shaft linings is discussed. Methods of shaft sinking are reviewed. Alternative schedules for the sinking of the shafts are described and a preferred schedule selected. The material presented and also the cost estimates are based on the requirements for a 2000 MW plant providing 20,000 MWh of storage with a nominal head of 4600 ft. Studies subsequently carried out, including power plant design, head optimization analyses for the overall UPH surface and underground configuration, and further refinement of selected designs, have modified some of the material given. DOE

**N83-13609#** Argonne National Lab., Ill.
**OPTIMAL SIZING OF HEATING SYSTEMS THAT STORE AND USE THERMAL ENERGY**
H. N. HERSH Jun. 1981 59 p refs
(Contract W-31-109-ENG-38)
(DE82-003011; ANL/SPG-18) Avail: NTIS HC A04/MF A01

An analysis of the factors that enter into the sizing of thermal energy storage (TES) space heating systems is given. These TES systems, having to fulfill the same thermal comfort functions as conventional space heating systems, have different operating characteristics and more severe constraints, and therefore require different and more critical sizing procedures. Thermal energy storage heating systems offer social and private benefits, and the achievement of these benefits depends in large part on proper sizing. Proper sizing is a probabilistic rather than a deterministic procedure, and is utility-specific as well. Analysis of experimental data obtained in field studies of TEST in New England provided information on the accuracy of equipment-sizing procedures used by vendors and on the consequences of undersizing and oversizing. Based on simulation studies and other techniques, additional useful sizing information was developed. The information implies the need for an upward adjustment of the sizing factor if the sizing is to be optimal for US climatological conditions and living habits. A summary and a general theoretical analysis of the information presented in this report are then combined to provide guidelines for optimally sizing TES systems. DOE

**N83-13610#** Public Service Co. of Indiana, Plainfield
**COMPRESSED-AIR ENERGY STORAGE PRELIMINARY DESIGN AND SITE-DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 1: EXECUTIVE SUMMARY Final Report**
Jun. 1982 129 p Sponsored by Electric Power Research Inst. Prepared in cooperation with Sargent and Lundy Engineers, Chicago and Westinghouse Electric Corp., Concordville, Pa. 9 Vol.
(Contract DE-AC02-78ET-29232; EPRI PROJ. 1081-3)
(DE82-019284; EPRI-EM-2351-VOL-1) Avail: NTIS HC A07/MF A01

The behavior and suitability of an aquifer-based compressed-air energy storage (CAES) facility was investigated. Project organization, site selection, aquifer geology, plant design, turbomachinery, and cost analysis are addressed. DOE

**N83-13611#** Public Service Co. of Indiana, Plainfield.
**COMPRESSED-AIR ENERGY STORAGE PRELIMINARY DESIGN AND SITE-DEVELOPMENT PROGRAM IN AN AQUIFER. VOLUME 2: UTILITY-SYSTEM PLANNING Final report**
Jun. 1982 111 p refs
(Contract DE-AC02-78ET-29232; ET-78-C-01-2159; EPRI PROJ. 1081-3)
(DE82-019993; EPRI-EM-2351-VOL-2) Avail: NTIS HC A06/MF A01

The benefits derived from the integration of a compressed air energy storage facility with a hypothetical electrical network were analyzed. The analysis was based on three study scenarios each having a target generation mix of 65% base, 25% intermediate, and 10% peaking capacity. Scenarios of 100% coal, 50% coal and 50% nuclear, and 100% nuclear base load capacity additions were examined. Final results of the analyses indicate favorable economics when compressed air energy storage is installed as an alternative to combustion turbine peaking capacity on a system with a significant amount of oil-fired generation. DOE

**N83-13612#** Gould, Inc., Rolling Meadows, Ill.
**DEVELOPMENT OF ZINC BROMIDE BATTERIES FOR STATIONARY ENERGY STORAGE Final Report, Nov. 1979 - Dec. 1981**
R. A. PUTT and A. ATTIA Jul. 1982 114 p Sponsored by Electric Power Research Inst.
(Contract DE-AC02-78ET-29345; EPRI PROJ. 635-2)
(DE82-019283; EPRI-EM-2497) Avail. NTIS HC A06/MF A01

The principal objective was to build and test for 50 cycles a 10-kW, 80-kWh prototype battery of the bipolar design with large electrodes (30 cm x 30 cm). Secondary objectives were to continue long-term studies on improvements in materials and processing and on life cycling of small laboratory cells. Secondary objectives were to continue long-term studies on improvements in materials and processing and on life cycling of small laboratory cells. The 80-kWh design was successfully constructed and tested, running 59 consecutive cycles from its first startup. The forced outage rate was zero, and the total downtime for repair and maintenance was 9.6 hours out of the 1728 elapsed-time hours. The system was operated at full power, but not at full capacity (design levels of 10 kW for 8 h) Energy efficiency was above 60% in the early cycles. The present design is the first of its kind and far from having optimum characteristics of the most suitable materials. Achievements of 70 to 75% electrochemical energy efficiency is believed to be feasible. DOE

**N83-13618#** Science Applications, Inc., Palo Alto, Calif
**COMPUTER-SIMULATION CODE FOR THE PREDICTION OF RELIABILITY AND AVAILABLE CAPACITY OF MODULAR ENERGY-STORAGE ARRAYS. VOLUME 1: OVERVIEW Final Report**
S. L. BASIN and R. D. HORN Aug. 1982 37 p Sponsored by Electric Power Research Inst. 2 Vol.
(Contract EPRI PROJ. 370-17)
(DE82-906445; EPRI-EM-2486-VOL-1) Avail: NTIS HC A03/MF A01

This report describes a computer simulation code that has been constructed for studying the reliability of arrays of energy storage components which are subject to renewal or repair. The measures of performance include: time to first failure of the array, time between successive failures, available capacity of the system (i.e., number of module hours available) between successive system failures as well as over the planned life of the system; number of system failures over the planned life of the systems; and number of module replacements over the planned life of the systems. At the present time the program is set up to handle two types of systems; simple systems consisting of series-parallel or parallel-series configurations of modules and compound systems in which the modules in the overall system array have been replaced y submodules, each having a series-parallel or parallel-series structure. The effect of periodic maintenance - e.g., the replacement of all failed modules every three or six months - may be studied in contrast to replacement of all failed modules at

the time of each system failure. The program allows for the combination of both of the above maintenance policies. It is assumed that all failed modules or submodules within the system are replaced by new ones. DOE

**N83-13627#** United Kingdom Atomic Energy Authority, Harwell (England).
**SECONDARY BATTERY REQUIREMENTS FOR SPACE USE IN THE LATE 1980'S 1990'S Final Report**
J. HYATT Paris ESA Apr. 1982 274 p refs
(Contract ESTEC-4404/80/NL-JS(SC))
(HL82/1200; ESA-CR(P)-1637) Avail. NTIS HC A12/MF A01

Secondary batteries, reverisble fuel cells and energy storage wheels were assessed. It is found that there is no system being developed for terrestrial applications that offers any potential to the space user, in low Earth orbits, better than the nickel/hydrogen and silver/hydrogen cells being developed specifically for space The advanced high temperature cells (the sodium/sulfur cells in particular) do offer potential for development to give a lighter battery in geosynchronous Earth orbit. Author (ESA)

**N83-13634#** National Materials Advisory Board, Washington, D. C.
**ASSESSMENT OF RESEARCH NEEDS FOR ADVANCED BATTERY SYSTEMS Final Report**
May 1982 197 p refs
(Contract DOE-ET-78-C-01-3431)
(PB82-227349, NMAB-390) Avail: NTIS HC A09/MF A01
CSCL 10C

The materials related research needs for advanced rechargeable storage battery systems were assessed Both aqueous and nonaqueous systems, to be used primarily in electric vehicles and electric utility load leveling applications, were examined It is concluded that research is needed on a wide spectrum of components and processes to improve the performance of such systems. Additionally, many of the problems are common to several types of battery cells; research on these generic problems warrants special priority An overview of the state of the art is provided along with a summary of recommendations, particularly concerning generic problems with storage batteries but also including those unique to individual systems. An outline of research needs is presented. GRA

**N83-13635#** Swedish Council for Building Research, Stockholm.
**SEASONAL THERMAL STORAGE: SWEDISH PRACTICE, DEVELOPMENTS AND COST PROJECTIONS**
P. MARGEN 1981 33 p refs
(PB82-232331; D4:1981) Avail: NTIS HC A03/MF A01 CSCL 10C

The types of heat store being developed in Sweden for seasonal storage of heat are discussed This type of storage allows summer excess heat from industrial waste heat plants, garbage burning plants and future central solar heat stations to be stored for winter use on district heating networks. Whereas above ground steel or concrete tanks are usually too expensive insulated earth pits, uninsulated rock caverns and deep ground schemes using rock or clay promise to achieve sufficiently low costs to justify storage when supplied with free or cheap summer treat. For all these concepts demonstration plants were or are being built in Sweden. GRA

**N83-13637#** Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).
**STATIONARY FLYWHEEL ENERGY STORAGE SYSTEMS**
A. GILHAUS, E HAU, G. GASSNER, G. HUSS, and H. SCHAUBERGER Jul. 1982 111 p refs Transl. into ENGLISH from the mono. "Stationare Schwungrad-Energiespeicher" 1981 Sponsored in part by the Commission of the European Communities
(PB82-238130; EUR-7088-DE) Avail. NTIS HC A06/MF A01 CSCL 13I

A study intended to discover industrial applications of Stationary Flywheel Energy Accumulators The economic value for the consumer and the effects on the power supply grid were investigated A possibility for energy storage by flywheels exists where energy otherwise lost can be used effectively as in brake energy storage in vehicles. The future use of flywheels in wind power plants also seems to be promising Attractive savings of energy can be obtained by introducing modern flywheel technology for emergency power supply units which are employed, for instance, in telecommunication systems. GRA

**N83-14414#** Los Alamos Scientific Lab , N. Mex.
**THE 30-MJ SUPERCONDUCTING MAGNETIC ENERGY STORAGE FOR BPA TRANSMISSION-LINE STABILIZER**
R. I SCHERMER 1981 20 p refs Presented at US-Japan Superconductive Magnetic Energy Storage Workshop, Madison, Wis., 19 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-002355; LA-UR-81-3040; CONF-811051-2) Avail. NTIS HC A02/MF A01

The development of a 30 MJ (8.4 kWh) superconducting magnetic energy storage (SMES) unit with a 10 MW converter which can provide system damping for low frequency oscillations is described. The coil is complete and all major components of the electrical and cryogenic systems were received and are tested. Computer control hardware is in place and software development is proceeding. Support system components and dewar lid are fabricated and foundation design is complete. GRA

**N83-14662** Minnesota Univ., Minneapolis.
**DESIGN OF PLYWOOD AND PAPER FLYWHEEL ROTORS Ph.D. Thesis**
D L HAGEN 1982 197 p
Avail: Univ. Microfilms Order No. DA8221276

Technical and economic design factors of cellulosic rotors are compared with conventional materials for stationary flywheel energy storage systems. Wood species, operation in a vacuum, assembly and costs of plywood rotors are evaluated Wound kraft paper, twine and veneer rotors are examined. Two bulb attachments are designed Support stiffness is shown to be constrained by the material strength, rotor configuration and speed ratio. Plywood moisture equilibrium during manufacture and assembly is critical. Disk shaping and rotor assembly are described Potential self-centering dynamic balancing methods and equipment are described Detailed measurements of the distribution of strengths, densities and specific energy of conventional Finnish Birch plywood and of custom made hexagonal Birch plywood are detailed. High resolution tensile tests were performed while monitoring the acoustic emissions with micoprocessor controlled data acquisition. Preliminary duration of load tests were performed on vacuum dried hexagonal birch plywood. Economics of cellulosic and conventional rotors were examined. Dissert Abstr.

**N83-14667*#** Case Western Reserve Univ , Cleveland, Ohio.
**ELECTROMAGNETIC STUDIES OF REDOX SYSTEMS FOR ENERGY STORAGE Annual Report, Dec. 1981 - Nov. 1982**
C. D. WU, D. SCHERSON, and E. YEAGER Nov. 1981 69 p refs
(Contract NAG3-219)
(NASA-CR-169593, NAS 1.26.169593; REPT-2) Avail. NTIS HC A04/MF A01 CSCL 10C

Both chromium and iron couples were studied on various electrode surfaces in acidic perchlorate solution by using rotating ring-disk techniques. It was found that chloride which forms inner sphere coordination complexes with the redox species enhances the electrode kinetics dramatically The effects of lead underpotential deposition and surface alloy formation on the kinetics of the chromium couple on gold were studied using both linear sweep voltammetry and potential step techniques. The lad underpotential deposition was found to slow down the kinetics of the reduction of the Cr species on gold surfaces although increase the hydrogen overvoltage. The effect on the chromium kinetics can be explained in terms of principally a double layer effect The underpotential deposition lead species with its positive charge results in a decrease in the concentration of the Cr species at

the electrode surface. Similar phenomena were also observed with bismuth underpotential deposition on gold for the iron couple.
R.J.F.

**N83-14683*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**THE NASA REDOX STORAGE SYSTEM DEVELOPMENT PROJECT, 1980**
Dec. 1982 73 p refs
(Contract DE-AI04-80AL-12726)
(NASA-TM-82940; E-1340; DOE/NASA/12726-18; NAS 1.15:82940) Avail: NTIS HC A04/MF A01 CSCL 10C

The technical accomplishments pertaining to the development of Redox systems and related technology are outlined in terms of the task elements: prototype systems development, application analyses, and supporting technology. Prototype systems development provides for a major procurement to develop an industrial capability to take the current NASA Lewis technology and go on to the design, development, and commercialization of iron-chromium Redox storage systems. Application analyses provides for the definition of application concepts and technology requirements, specific definition studies, and the identification of market sectors and their penetration potential. Supporting technology includes both in house and contractual efforts that encompass implementation of technology improvements in membranes, electrodes, reactant processing, and system design. The status of all elements is discussed. J.M.S.

**N83-14742#** EIC, Inc., Newton, Mass.
**AMBIENT TEMPERATURE RECHARGEABLE LITHIUM BATTERY Final Report, 1 Mar. 1981 - 28 Feb. 1982**
K. M. ABRAHAM, D. I. NATWIG, P. B. HARRIS, and J. W. AVERY Fort Belvoir, Va. Army Electronics Research and Development Command Aug. 1982 102 p refs
(Contract DAAK20-81-C-0378; DA PROJ. 1L1-62705-AH-94)
(AD-A119297; C-655; DELET-TR-81-0378-F) Avail: NTIS HC A06/MF A01 CSCL 10C

Cr0.5V0.5S2 has been characterized as a useful positive electrode material for rechargeable Li cells. The positive electrode reaction involves intercalation of Li during discharge and deintercalation of Li during recharge. A discharge capacity equivalent to nearly le-/Cr0.5Vo.5S2 has been obtained in early cycles at low rates. The average capacity which could be realized in long-term cycling appears to be 0.7-0.8e-/Cr0.5V0.5S2. Laboratory cells exceeded 200 deep discharge cycles. Although Cr0.5V0.5S2 and its Li intercalates are good electronic conductors, optimum rate and rechargeability were found in electrodes with 15-20 weight percent carbon. Because of this relatively large amount of carbon, the volumetric energy density achieved in cells has been significantly lower than what was anticipated at the outset of the program. The major objective of the program, development of a technology base for the construction of large rechargeable Li cells, has been accomplished. Cells with theoretical capacities of 10 and 20 Ah have been constructed and tested. In limited cycle tests, these large cells performed as well as laboratory test cells.
GRA

**N83-14743#** Naval Surface Weapons Center, White Oak, Md. Research and Technology Dept.
**DEVELOPMENT OF IMPROVED SEPARATORS FOR ALKALINE ZINC BATTERIES Final Report**
W. A. PARKHURST 28 Feb. 1982 18 p refs
(Contract SF43431302)
(AD-A119150; AD-F500064; NSWC/TR-82-128) Avail: NTIS HC A02/MF A01 CSCL 10C

This report is a summary of the development of separator materials for rechargeable alkaline zinc batteries over a seven year period. It summarizes studies performed during the earlier years of polyphenylquinoxaline (PPQ) polymer blends as separator materials. The expense of large scale production and the marginal improvement demonstrated for PPQ blends over existing cellulose based separator materials led to redirection of the work. The current limited effort in the development of nickel coated separator materials is described. Because of a lack of funding, the characterization of nickel coated separator materials was not completed. Further characterization, testing and evaluation of the feasibility of such electrically conductive separator film materials is recommended.
GRA

**N83-14748#** Oak Ridge National Lab., Tenn.
**INDUSTRIAL THERMAL ENERGY STORAGE: WHAT ARE THE POSSIBILITIES?**
M OLSZEWSKI 1981 23 p refs Presented at Intern. Flame Res. Assoc. Meeting, Chicago, 5 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-001494; CONF-811058-1) Avail: NTIS HC A02/MF A01

Some of the identified applications for thermal energy storage (TES) in the industrial sector are presented The TES is generally applicable in reject energy recovery and reuse systems where either the energy source or use exhibits a fluctuating pattern of availability or need. It is also applicable when a mismatch occurs between the time that the heat is available and the time it is needed.
DOE

**N83-14749#** Los Alamos Scientific Lab., N. Mex.
**DESIGN AND TESTING OF A 13.75 MW CONVERTER FOR A SUPERCONDUCTING MAGNETIC-ENERGY-STORAGE SYSTEM**
H. J. BOENIG, R. D. TURNER, C. L. NEFT, and K. H. SUEKER 1981 5 p refs Presented at the 9th Symp. on Engr. of Fusion Res., Chicago, 26-29 Oct. 1981
(Contract W-7405-ENG-36)
(DE82-002385; LA-UR-81-3132; CONF-811040-70) Avail. NTIS HC A02/MF A01

A 30 MJ superconducting magnetic energy storage system to act as a transmission line stabilizer is described. Two 6 MVA transformers and a 5.5 kA, + 2.5 kV converter connects the superconducting coil to the 13.8 kV bus and regulates the power flow between the coil and the three phase system. The design philosophy for the converter including its control and protection system is given. The converter was tested with 10% overvoltage at no load, with 10% overcurrent at zero output voltage and with a watercooled resistive load of about 1 MW. These test results show that the converter meets the expected full load operating conditions.
DOE

**N83-14754#** Pacific Northwest Lab., Richland, Wash.
**AQUIFER STABILITY INVESTIGATION**
R D. ALLEN and T. J. DOHERTY Sep. 1981 18 p refs Presented at Compressed Air Energy Storage Seminar, Chicago, 17 Sep. 1981
(Contract DE-AC06-76RL-01830)
(DE82-003831; PNL-9884; CONF-810997-2) Avail: NTIS HC A02/MF A01

The reservoir Stability Studies Program had four major activities: a state-of-the-art survey to establish preliminary stability criteria and identify areas requiring research and development; numerical modeling; laboratory testing to provide data for use in numerical models and to investigate fundamental rock mechanics, thermal, fluid, and geochemical response of aquifer materials; and field studies to verify the feasibility of air injection and recovery under CAES conditions in an aquifer, to validate and refine the stability criteria, and to evaluate the accuracy and adequacy of the numerical and experimental methodologies developed in previous work. Three phases of study, including preliminary criteria formulation, numerical model development, and experimental assessment of CAES reservoir materials have been completed. Present activity consists of construction and operation of the aquifer field test, and associated numerical and experimental work in support of that activity.
DOE

**N83-14755#** Pacific Northwest Lab., Richland, Wash.
**ADVANCED CONCEPTS: THE SECOND GENERATION OF COMPRESSED AIR-ENERGY STORAGE TECHNOLOGY**
L. D. KANNBERG Sep. 1981 12 p refs Presented at Compressed Air Energy Storage Seminar, Chicago, 17 Sep. 1981
(Contract DE-AC06-76RL-01830)
(DE82-003838; PNL-SA-9885; CONF-810997-1) Avail: NTIS HC A02/MF A01

A description and assessment is provided for four second generation compressed air energy storage (CAES) concepts; abiabatic CAES, hybrid CAES, CAES with coal gasification (CG), and CAES with pressurized fluidized bed combustion (PFBC). These are based on information provided in conceptual design studies performed by Acres American, Inc., United Engineers and Constructors, and United Technologies Research Center. The assessment covers consideration of the technological readiness, relative economic benefits and operational viability of each concept. It was concluded that the adiabatic CAES concept appears to be the most attractive candidate for utility application in the near future. It is operationally viable, economically attractive compared with competing concepts, and will require relatively little additional development before commercialization. It was estimated that a utility could start the design of a commercial plant in 2 to 3 years if research regarding TES system design is undertaken in a timely manner. DOE

**N83-14758#** Pacific Northwest Lab., Richland, Wash
**ECONOMIC COMPARISON OF CAES DESIGNS EMPLOYING HARDROCK, SALT AND AQUIFER STORAGE RESERVOIRS**
R. W. REILLY and R. B. SCHAINKER (Electric Power Research Inst.) 1981 9 p refs Presented at the Compressed Air Energy Storage Seminar, Chicago, 17 Sep. 1981
(Contract DE-AC06-76RL-01830)
(DE82-003833; PNL-SA-9890; CONF-810997-3) Avail: NTIS HC A02/MF A01

The economic performance of three compressed air energy storage (CAES) designs is briefly examined Each design was developed under different assumptions and constraints, and each employed a different ytpe of air storage facility: a hardrock-mined cavity, a solution mined salt deposit, and an aquifer. The results indicate that aquifer and salt storage facilities cost roughly 60 to 70% of the equivalent hardrock mined cavern In this comparison the aquifer storage facility was somewhat less expensive than the salt cavity, but this difference could be reversed with different salt and/or aquifer characteristics For instance, if the aquifer was less permeable, then more wells would be required for the same power level, and total storage cost would be higher The major difference between the plant cost estimates lies not in the cost of storage facilities, but rather in vendor estimates of turbomachinery cost. And, since turbomachinery contributes about half of total plant cost, this difference could be critical to the decision to build a CAES plant. DOE

**N83-14759#** Sandia Labs , Albuquerque, N. Mex.
**PARAMETRIC BEHAVIOR OF THE CIRCULATING ZINC-BROMINE BATTERY**
E. KANTNER, R. BELLOWS, H. EINSTEIN, P. GRIMES, P. MALACHESKY, and K. NEWBY 1981 17 p refs Presented at Electrochem. Soc. General Session, Pennington, N. J., 11 Oct. 1981
(Contract DE-AC04-76DP-00789)
(DE82-001910; SAND-81-7158C; CONF-811084-1) Avail: NTIS HC A02/MF A01

Graphs are presented depicting polarization data of bipolar batteries of varying capacity ratings, battery voltage vs c/d time of bipolar batteries of varying capacity ratings. Coulomb efficiency vs zinc loading, Coulomb efficiency vs c/d rate, voltage efficiency vs c/d rate, and energy efficiency vs c/d rate DOE

**N83-15169*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**RESEARCH AND TECHNOLOGY, LEWIS RESEARCH CENTER Annual Report, 1982**
1982 47 p refs
(NASA-TM-83038, NAS 1.15:83038) Avail: NTIS HC A03/MF A01 CSCL 05B

Aeronautics, space, and terrestrial energy research is covered. Energy conversion processes and systems for propulsion in the atmosphere, in space, and on the ground are reviewed. Electric energy generation and storage for both terrestrial and space applications and materials and structures for such systems are also reviewed. N.W.

**N83-15372*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**DEVELOPMENT AND EVALUATION OF POLYVINYL-ALCOHOL BLEND POLYMER FILMS AS BATTERY SEPARATORS**
M. A. MANZO Dec. 1982 25 p refs
(NASA-TM-82981; E-1412; NAS 1.15:82981) Avail: NTIS HC A02/MF A01 CSCL 10C

Several dialdehydes and epoxies were evaluated for their suitability as cross-linkers Optium concentrations of several cross-linking reagents were determined. A two-step method of cross-linking, which involves treatment of the film in an acid or acid periodate bath, was investigated and dropped in favor of a one-step method in which the acid catalyst, which initiates cross-linking, is added to the PVA - cross-linker solution before casting The cross-linking was thus achieved during the drying step. This one-step method was much more adaptable to commercial processing Cross-linked films were characterized as alkaline battery separators. Films were prepared in the lab and tested in cells in order to evaluate the effect of film composition and a number of processing parameters on cell performance These tests were conducted in order to provide a broader data base from which to select optimum processing parameters. Results of the separator screening tests and the cell tests are discussed
M G.

**N83-15587#** Los Alamos Scientific Lab., N. Mex.
**HIGH-CURRENT PULSES FROM INDUCTIVE ENERGY STORES**
S. L. WIPF 1981 7 p refs Presented at the 9th Symp. on Eng. Probl of Fusion Res., Chicago, 26-29 Oct 1981
(Contract W-7405-ENG-36)
(DE82-004366; LA-UR-81-3421; CONF-811040-119) Avail: NTIS HC A02/MF A01

Superconducting inductive energy stores can be used for high power pulse supplies if a suitable current multiplication scheme is used The concept of an inductive Marx generator is superior to a transformer. A third scheme, a variable flux linkage device, is suggested; in multiplying current it also compresses energy Its function is in many ways analogous to that of a horsewhip. Superconductor limits indicate that peak power levels of TW can be reached for stored energies above 1 MJ. DOE

**N83-15845#** United Technologies Corp , East Hartford, Conn
**ALKALINE FUEL CELLS FOR PRIME POWER AND ENERGY STORAGE**
J. K. STEDMAN *In* R and D Associates Proc. of the AFOSR Spec. Conf. on Prime-Power for High Energy Space Systems, Vol. 1 42 p 1982
Avail: NTIS HC A99/MF A01 CSCL 10A

Alkaline fuel cell technology and its application to future space missions requiring high power and energy storage are discussed. Energy densities exceeding 100 watthours per pound and power densities approaching 0.5 pounds per kilowatt are calculated for advanced systems. Matenals research to allow reversible operation of cells for energy storage and higher temperature operation for peaking power is warranted. Author

**N83-15943#** Oak Ridge National Lab , Tenn Engineering Technology Div
**THE ORNL THERMAL ENERGY STORAGE PROGRAM: TECHNICAL SUPPORT**
R N. MCGILL 1981 17 p refs Presented at the Ann Thermal and Chem Storage Contractors' Rev Meeting, Washington, D C , 14-16 Sep 1981 2 Vol
(Contract W-7405-ENG-26)
(DE81-030805; CONF-810940-8) Avail NTIS HC A02/MF A01

The three major elements of the technology development program of the Oak Ridge National Laboratory are discussed Computer modeling and bench scale experiments of phase change materials, the Thermal Energy Storage Test Facility, and earth thermal storage-assisted heat pump studies are discussed Each of these program elements are discussed with regard to their objectives and the progress of each during the past year Also, indications of the direction that each project is taking and the progress anticipated for next year are given DOE

**N83-15944#** Oak Ridge National Lab , Tenn Energy Technology Div
**THE ORNL THERMAL ENERGY STORAGE PROGRAM**
J F MARTIN 1981 15 p refs Presented at Thermal Energy Storage Ann Contractors' Rev Meeting, Washington, D C , 14-16 Sep 1981 2 Vol
(Contract W-7405-ENG-26)
(DE81-032001, CONF-810940-9) Avail NTIS HC A02/MF A01

Development of thermal energy storage technologies and subsystems is discussed Oak Ridge National Laboratory activities in the areas of building heating and cooling and industrial applications are discussed Specific subcontract and in-house activities are summarized and the results of research conducted during FY 1981 are given The major thrust of next year's program is given. DOE

**N83-15945#** Institute of Gas Technology, Chicago, Ill
**ADVANCED HIGH-TEMPERATURE THERMAL ENERGY STORAGE MEDIA FOR INDUSTRIAL APPLICATIONS**
T. D. CLEAR and R. T WEIBEL 1981 7 p refs Presented at the ANN. Contractors' Rev Meeting on Thermal and Chem Storage, Tysons Corner, Va., 16 Sep 1981
(Contract W-7405-ENG-26)
(DE82-000161, CONF-810940-16) Avail NTIS HC A02/MF A01

An advanced thermal energy storage (TES) media concept based on use of carbonate salt/ceramic composite materials is being developed for industrial process and reject heat applications. This paper describes the composite latent/sensible media concept and its potential advantages over state-of-the-art latent heat systems Media stability requirements, on-going materials development efforts and planned TES performance evaluation tests are discussed. DOE

**N83-15946#** New Mexico Univ., Albuquerque Dept of Mechanical Engineering.
**PERFORMANCE OF LABYRINTH-STRATIFIED WATER-STORAGE SYSTEM FOR HEATING AND COOLING**
M. W. WILDIN 1981 9 p refs Presented at the Ann. Contractors' Rev Meeting on Thermal and Chem. Storage, Tysons Corner, Va , 16 Sep 1981
(Contract W-7405-ENG-26)
(DE82-000107, CONF-810940-11) Avail: NTIS HC A02/MF A01

The performance of a set of thermal storage tanks using water as the storage medium and the labyrinth technique to help maintain separation of warmer and cooler water was monitored during most of the 1980-81 heating season and is being monitored during the 1981 cooling season. The results indicate the effectiveness of this technique for leveling of the power drawn from a utility. They also indicate the potential for energy conservation via heat recovery during the heating season. The scheme was incorporated in thermal storage tanks constructed for the Mechanical Engineering Building at the University of New Mexico. DOE

**N83-15947#** North Carolina State Univ , Raleigh Dept of Materials Science
**EVALUATION OF OLIVINE CERAMIC REFRACTORIES FOR THERMAL-ENERGY-STORAGE APPLICATION**
H PALMOUR, B M GAY, and R L COCHRAN 1981 7 p Presented at the Ann Contractors' Rev Meeting on Thermal and Chem Storage, Tysons Corner, Va , 16 Sep 1981
(Contract W-7405-ENG-26)
(DE82-000108, CONF-810940-27) Avail. NTIS HC A02/MF A01

The degree of improvement in thermal and mechanical performance that can be obtained with an olivine thermal storage brick made of domestic materials using advanced processing techniques compared with state-of-the-art as represented by commercial European bricks is discussed The goals and results of the study are given DOE

**N83-15948#** Purdue Univ., Lafayette, Ind School of Mechanical Engineering.
**THERMAL ENERGY STORAGE TESTING FACILITIES**
R J SCHOENHALS, S H ANDERSON, L W STEVENS, W. R LASTER, and M R ELTER 1981 7 p refs Presented at the Ann Contractors Rev Meeting on Thermal and Chem. Storage, Tysons Corner, Va , 14-16 Sep 1981
(Contract W-7405-ENG-26)
(DE82-000110, CONF-810940-24) Avail NTIS HC A02/MF A01

Development of a prototype testing facility for performance evaluation of electrically heated thermal energy storage units is discussed Laboratory apparatus and test procedures are being evaluated by means of measurements and analysis Testing procedures were improved, and test results were acquired for commercially available units A 30 kW central unit and several smaller individual room-size units were tested DOE

**N83-15949#** Argonne National Lab , Ill
**FIELD EVALUATION AND ASSESSMENT OF THERMAL ENERGY STORAGE FOR RESIDENTIAL SPACE HEATING**
H. N HERSH 1981 6 p refs Presented at Ann Contractors' Rev. Meeting on Thermal and Chem. Storage, Washington, D.C., 14-16 Sep 1981
(Contract W-7405-ENG-26)
(DE82-000164; CONF-810940-23) Avail NTIS HC A02/MF A01

Based on New England field test data covering two heating seasons, thermal energy storage (TES) is technically viable and acceptable to its users An analysis is underway comparing the efficiency of electricity utilization of direct and storage heating systems. Economics (higher cost of TES systems and changes in rate structures) represents the largest impediment to sufficient market penetration. DOE

**N83-15950#** Oak Ridge National Lab , Tenn.
**MATHEMATICAL MODELING OF TES SUBSYSTEMS**
A D. SOLOMON 1981 5 p refs Presented at Ann Contractors' Rev Meeting on Thermal and Chem Storage, Washington, D.C., 14-16 Sep 1981
(Contract W-7405-ENG-26)
(DE82-000168, CONF-810940-21) Avail: NTIS HC A02/MF A01

Results of research into phase change models for latent heat storage are described. These are of both a simulation and analytical nature and continue the work of past years in this effort A simulation code for the cooling an dehumidification of an air stream due to phase change material cylinders is discussed. The development of a bogus specific heat for phase change calculations is discussed. DOE

**N83-15956#** Oak Ridge National Lab., Tenn.
**ONCE-THROUGH HEAT TRANSPORT AND SEASONAL STORAGE FOR CITY OF BELLINGHAM**
I. OLIKER (Burns and Roe, Inc., Oradell, N J.) and M OLSZEWSKI 1981 12 p refs Presented at Intern. Energy Storage Conf., Seattle, Wash , 19 Oct. 1981
(Contract W-7405-ENG-26)
(DE82-001501; CONF-811066-1) Avail: NTIS HC A02/MF A01

A conceptual design of a once-through district heating system utilizing industrial waste heat was developed for the city of Bellingham, Washington Two once-through designs are evaluated Case 1 is based on an assumption that 67 MWt can be obtained from an aluminum plant and supplementary heat sources and does not require a seasonal thermal storage facility. Case 2 is based on the extraction of 45 MWt from the aluminum plant and requires a seasonal thermal storage facility These once-through systems were compared with the closed district heating system design which uses a two-pipe heat transport arrangement that returns the used water to the aluminum plant. In 1980 dollars, once through system case 1 would provide an economic advantage of about $10.7 million over the closed system. Case 2 would incur a disadvantage of about $9.1 million in comparison with the closed system, largely because of the high cost of seasonal thermal storage tanks DOE

**N83-15957#** Energy Utilization Systems, Inc , Pittsburgh, Pa
**SURVEY OF UTILITY LOAD MANAGEMENT PROJECTS: THIRD REVISED REPORT**
Oct. 1981 342 p refs
(Contract W-7405-ENG-26)
(DE82-000888; ORNL/SUB-80-13644-1) Avail NTIS HC A15/MF A01

The 86 utility sponsored thermal energy storage (TES) projects and 158 communiation and load control (C&CL) projects are described These projects are grouped into two mainsections (TES and C&CL) and into several subsections, according to the type of TES or C&CL system or device utilized. Each subsection contains a technical description of the particular system or device, a discussion of installed costs, if such information is available, and a listing of the manufacturer(s) of the hardware A comprehensive table of all utility projects that involve the use of this hardware is presented Additional information on selected projects in expanded summary forms is presented These projects were selected based on their uniqueness, scope, maturity, results or because they are representative of utility projects utilizing similar hardware GRA

**N83-16257*#** Gould, Inc , Rolling Meadows, Ill
**IMPROVED SCR AC MOTOR CONTROLLER FOR BATTERY POWERED URBAN ELECTRIC VEHICLES Final Report**
T S. LATOS Dec 1982 319 p refs
(Contract DEN3-60; DE-AI01-77CS-51044)
(NASA-CR-167919, DOE/NASA/0060-82/1, NAS 1.26.167919, REPT-815-008) Avail NTIS HC A14/MF A01 CSCL 13F

An improved ac motor controller, which when coupled to a standard ac induction motor and a dc propulsion battery would provide a complete electric vehicle power train with the exception of the mechanical transmission and drive wheels was designed In such a system, the motor controller converts the dc electrical power available at the battery terminals to ac electrical power for the induction motor in response to the drivers commands The performance requirements of a hypothetical electric vehicle with an upper weight bound of 1590 kg (3500 lb) were used to determine the power rating of the controller. Vehicle acceleration capability, top speed, and gradeability requisites were contained in the Society of Automotive Engineers (SAE) Schedule 227a(d) driving cycle. The important capabilities contained in this driving cycle are a vehicle acceleration requirement of 0 to 72 4 kmph (0 to 45 mph) in 28 seconds a top speed of 88.5 kmph (55 mph), and the ability to negotiate a 10% grade at 48 kmph (30 mph). A 10% grade is defined as one foot of vertical rise per 10 feet of horizontal distance S L

# 08

# GENERAL

**A83-17115**
**ADVANCES IN ENERGY TECHNOLOGY; PROCEEDINGS OF THE EIGHTH ANNUAL UMR-DNR CONFERENCE ON ENERGY, UNIVERSITY OF MISSOURI-ROLLA, ROLLA, MO, NOVEMBER 4-7, 1981**
H J. SAUER, JR., (ED.) and B E HEGLER Conference sponsored by the University of Missouri-Rolla and Missouri Department of Natural Resources Rolla, MO, University of Missouri-Rolla, 1982 332 p

Papers on various topics of energy conservation, new passive solar heating and storage devices, governmental particiaption in developing energy technologies, and the development of diverse energy sources and safety features are presented Attention is given to recent shifts in the federal and state goverenment roles in energy research, development and economic incentives The applications of passive solar walls, flat plate collectors and trombe walls as retorfits for houses, institutions, and industries were examined. Attention was given to the implementation of wind power by a zoo and the use of spoilers as speed control devices in a Darrieus wind turbine Aspects of gasohol, coal, synfuel, and laser-pyrolyzed coal products use are investigated Finally, the economic, social, and political factors influencing energy system selection are explored, togeter with conservation practices in housing, government, and industry, and new simulators for enhancing nuclear power plant safety M S K

**A83-17701**
**HEAT TRANSFER - A REVIEW OF 1981 LITERATURE**
E R. G ECKERT, R. J GOLDSTEIN, S. V. PATANKAR, E. PFENDER, J. W RAMSEY, T. W. SIMON, and E. M. SPARROW (Minnesota, University, Minneapolis, MN) International Journal of Heat and Mass Transfer, vol. 25, Dec 1982, p 1783-1812. refs

Results that have been published in the open literature covering various fields of heat transfer during 1981 are surveyed. Preliminarily, developments in the field during 1981 are summarized The subjects reviewed in detail include conduction, channel flow, boundary layer and external flows, flow with separated regions, internal and external flows in natural convection, convection from rotating surfaces, combined heat and mass transfer, change of phase, radiation in participating media, surface radiation, MHD, numerical methods, heat exchangers and gas pipes, general heat transfer applications, solar energy, and plasma heat transfer. An extensive list of references is included. C D.

**A83-18581*#** National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va
**EXPERIMENTAL FEASIBILITY OF THE AIRBORNE MEASUREMENT OF ABSOLUTE OIL FLUORESCENCE SPECTRAL CONVERSION EFFICIENCY**
F E. HOGE (NASA, Wallops Flight Center, Wallops Island, VA) and R N SWIFT (EG & G Washington Analytical Services Center, Inc., Pocomoke City, MD) Applied Optics, vol. 22, Jan 1, 1983, p 37-47 refs

Airborne lidar oil spill experiments carried out to determine the practicability of the AOFSCE (absolute oil fluorescence spectral conversion efficiency) computational model are described The results reveal that the model is suitable over a considerable range of oil film thicknesses provided the fluorescence efficiency of the oil does not approach the minimum detection sensitivity limitations of the lidar system. Separate airborne lidar experiments to demonstrate measurement of the water column Raman conversion efficiency are also conducted to ascertain the ultimate feasibility of converting such relative oil fluorescence to absolute values. Whereas the AOFSCE model is seen as highly promising, further airborne water column Raman conversion efficiency experiments with improved temporal or depth-resolved waveform calibration

and software deconvolution techniques are thought necessary for a final determination of suitability. C R

**N83-10379*#** Hughes Aircraft Co , Torrance, Calif Electron Dynamics Div
**FABRICATION AND DEVELOPMENT OF SEVERAL HEAT PIPE HONEYCOMB SANDWICH PANEL CONCEPTS Final Report**
H. J. TANZER Jun 1982 55 p refs
(Contract NAS1-16556)
(NASA-CR-165962, NAS 1.26.165962) Avail. NTIS HC A04/MF A01 CSCL 20D

The feasibility of fabricating and processing liquid metal heat pipes in a low mass honeycomb sandwich panel configuration for application on the NASA Langley airframe-integrated Scramjet engine was investigated A variety of honeycomb panel facesheet and core-ribbon wick concepts was evaluated within constraints dictated by existing manufacturing technology and equipment The chosen design consists of an all-stainless steel structure, sintered screen facesheets, and two types of core-ribbon; a diffusion bonded wire mesh and a foil-screen composite. Cleaning, fluid charging, processing, and process port sealing techniques were established The liquid metals potassium, sodium and cesium were used as working fluids Eleven honeycomb panels 15 24 cm X 15.24 cm X 2 94 cm were delivered to NASA Langley for extensive performance testing and evaluation, nine panels were processed as heat pipes, and two panels were left unprocessed Author

**N83-11794#** Army Construction Engineering Research Lab , Champaign, Ill. Facilities Systems Div
**CAEDS: COMPUTER-AIDED ENGINEERING AND ARCHITECTURAL DESIGN SYSTEM Final Report**
J. H. SPOONAMORE Aug. 1982 23 p refs Presented at the Army Sci. Conf., West Point, N.Y , 15-18 Jun 1982
(Contract DA PROJ 4A7-62731-AT-41)
(AD-A117972, CERL-TM-P-133) Avail NTIS HC A02/MF A01 CSCL 09B

The U S. Army Corps of Engineers Construction Engineering Research Laboratory is developing the Computer-Aided Engineering and Architectural Design System (CAEADS) to support the design of military facilities CAEADS' support will start with initial requirements for a facility, and continue through concept and final design and the production of construction drawings, specifications and cost estimates The CAEADS system will be integrated based on a central source of design information used by all the disciplines in the design process users, project planners, architects, engineers, specification writers, and cost estimators and drafters. In October of 1981, the integration of the concept design tools of the CAEADS system was completed and a test initiated involving 200 projects in the Military Construction Army (MCA) FY84 program. This integrated system, called Concept CAEADS, is used to support preliminary design, from project requirements through to the 25 percent design level. Concept CAEADS provides tools for project information retrieval, facility layout, functional evaluation, energy evaluation, cost estimating and production of drawings During the period 1 October 81 to February 82, one architectural engineering firm tested and used Concept CAEADS to design to 25 percent these 200 MCA projects. The findings of the test suggest that substantial design cost reductions will be realized. GRA

**N83-12736#** World Meteorological Organization, Geneva (Switzerland).
**TECHNICAL CONFERENCE ON CLIMATE: AFRICA**
1982 541 p refs In ENGLISH and FRENCH Conf. held at Arusha, United Republic of Tanzania, 25-30 Jan 1982
(WMO-596, ISBN-92-63-00596-6) Avail: NTIS MF A01; print copy available at WMO, Geneva SW FR 35

Ways of using climatological data and knowledge to improve the efficiency of major economic activities and to alleviate the hazards of extreme climatic conditions were discussed. Food production, energy and water resources, and land use were studied

**N83-12737#** Nairobi Univ (Kenya) Dept of Meteorology
**THE CLIMATE OF AFRICA, INCLUDING FEASIBILITY STUDY OF CLIMATE ALERT SYSTEM**
G C. ASNANI *In* WMO Tech Conf on Climate Africa p 101-129 1982 refs
Avail NTIS MF A01, print copy available at WMO, Geneva SW FR 35

The state of the art of climatology is reviewed, and the main influences on, and regional variations of, the climate of Africa are discussed. A medium and long-range weather forecasting system which predicts climate hazards and the impact of climate on society is proposed. The advantages of satellite meteorology are considered Exploitation of inexhaustible energy sources (Sun, wind) is mentioned Author (ESA)

**N83-14016*#** Jet Propulsion Lab , California Inst of Tech , Pasadena
**PUBLICATIONS OF THE JET PROPULSION LABORATORY, 1981**
15 Sep. 1982 39 p Sponsored by NASA
(NASA-CR-169519; JPL-BIBL-39-23, NAS 1 26.169519) Avail NTIS HC A03/MF A01 CSCL 05B

Over 500 externally distributed technical reports released during 1981 that resulted from scientific and engineering work performed, or managed by Jet Propulsion Laboratory are listed by primary author Of the total number of entries, 311 are from the biomonthly Deep Space Network Progress Report, and its successor, the Telecommunications and Data Acquisition Progress Report. A R.H.

**N83-15870#** Arizona State Univ., Tempe Dept of Mechanical and Energy Systems Engineering
**SOME MATERIAL IMPLICATIONS OF SPACE NUCLEAR REACTORS (NON-FUEL MATERIALS) Final Report**
J F MORRIS *In* R and D Associates Proc of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol 2 13 p 1982
Avail: NTIS HC A99/MF A01

Nonfuel materials for space nuclear reactors, high temperature alloys and electric isolators are discussed M G.

**N83-15877#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**DEEP IMPURITY TRAPPING CONCEPTS FOR POWER SEMICONDUCTOR DEVICES Final Report**
G. R. SUNDBERG *In* R and D Associates Proc of the AFOSR Spec Conf on Prime-Power for High Energy Space Systems, Vol 2 39 p 1982 refs
Avail: NTIS HC A99/MF A01 CSCL 20L

High voltage semiconductor switches using deep impurity doped silicon now appear feasible for high voltage (1-100 kV), high power (10 Kw) switching and protection functions for future space power applications Recent discoveries have demonstrated several practical ways of gating deep impurity doped silicon devices in planar configurations and of electrically controlling their characteristics, leading to a vast array of possible circuit applications. A new family of semiconductor switching devices and transducers are possible based on this technology New deep impurity devices could be simpler than conventional p-n junction devices and yet use the same basic materials and processing techniques In addition, multiple functions may be possible on a single device as well as increased ratings Author

**N83-15880*#** National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
**GROWTH OF DIAMONDLIKE FILMS FOR POWER APPLICATIONS Final Report**
B. BANKS *In* R and D Associates Proc of the AFOSR Spec. Conf on Prime-Power for High Energy Space Systems, Vol. 2 33 p 1982 refs
Avail: NTIS HC A99/MF A01

Diamond has a high thermal conductivity (approximately 5 times that of copper) and is an ideal heat sink material for high power

semiconductor devices as well as being of interest as a semiconductor material. Numerous vacuum deposition processes are being evaluated by NASA-LeRC which have demonstrated the capability to deposit carbon films having some of the properties of diamond. Current activities include investigation of high deposition rate vacuum processes suitable for synthesis of diamondlike carbon films. The results of recent film characterization tests are reported. Author

**N83-15881#** Naval Research Lab , Washington, D. C.
**CERAMICS FOR HIGH POWER SOURCES IN SPACE Final Report**
R. W RICE *In* R and D Associates Proc. of the AFOSR Spec. Conf on Prime-Power for High Energy Space Systems, Vol 2 23 p 1982 refs
Avail. NTIS HC A99/MF A01

The general potential issues, and forms, of using ceramics in high power sources in space are first briefly reviewed; then some specific examples of using ceramics in energy systems are outlined. Next general ceramic research needs are discussed followed by a discussion of the research opportunities that are seen for ceramics; namely ceramic composites, fiber/whisker processing (especially by polymer pyrolysis), ternary and higher order compounds, and mimicking certain natural fiber-or biostructures. Author

**N83-15882*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va
**MATIERIALS TECHNOLOGY FOR LARGE SPACE STRUCTURES Final Report**
C. P. BLANKENSHIP and D. R. TENNEY *In* R and D Associates Proc. of the AFOSR Spec Conf. on Prime-Power for High Energy Space Systems, Vol. 2 38 p 1982 refs
Avail: NTIS HC A99/MF A01

Several of the key material technology needs that were identified for large space structures are outlined. They include lightweight structural materials, materials durability in the space environment, and some special aspects of materials fabrication technology. Examples of current materials research directed toward large space structures are described. Additional research needs and opportunities are noted A short bibliography is included of selected references that describe large space structural concepts and related technology needs in detail. R J.F

**N83-15883#** Naval Research Lab., Washington, D C. Lab. for the Structure of Matter.
**STRUCTURAL CHARACTERIZATION OF MATERIALS FOR HIGH ENERGY SPACE SYSTEMS Final Report**
R. GILARDI *In* R and D Associates Proc. of the AFOSR Spec. Conf on Prime-Power for High Energy Space Systems, Vol. 2 20 p 1982
Avail NTIS HC A99/MF A01

A review is given describing the use of diffraction techniques for the characterization of the atomic arrangements of materials in the amorphous, crystalline and fibrous forms. This research relates structure to function or to physical and chemical properties. The techniques of X-ray, neutron and electron diffraction are employed. The resulting diffraction patterns are transformed into detailed structural information An additional special technique involves the use of synchrotron radiation. It is of particular significance to studies of small samples, surfaces and anomalous dispersion applications. R J F

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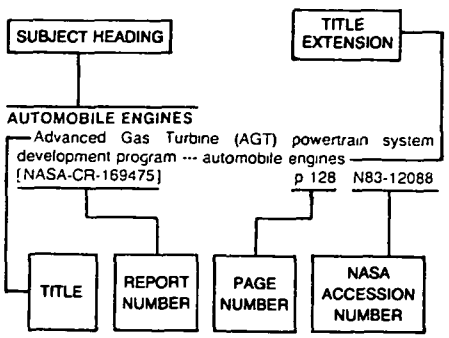


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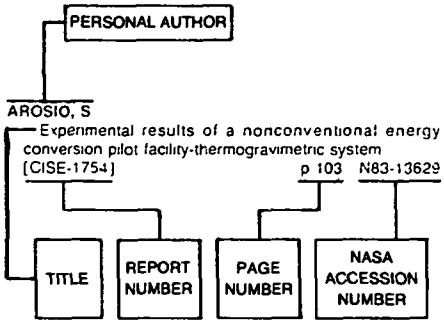


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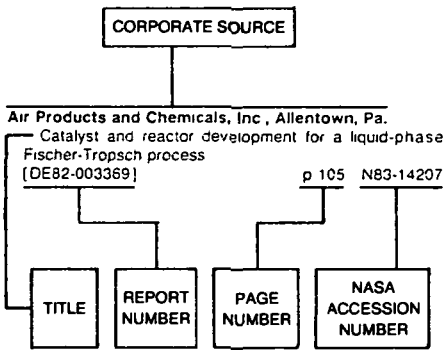


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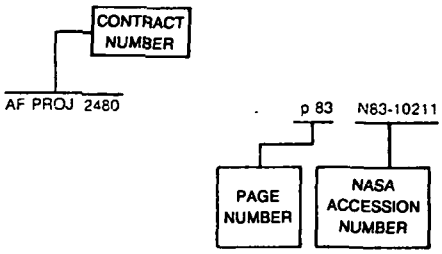


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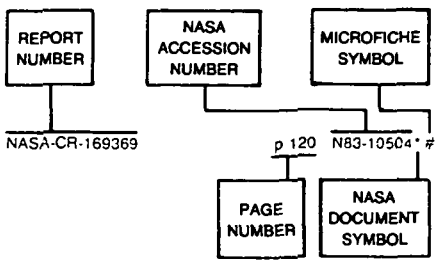


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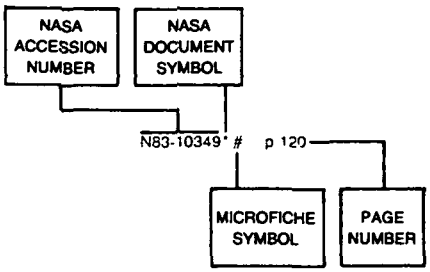


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